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Disease and Age Pattern of Hospitalization and Cost of Treatment in India: 1995-2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016990
Article Type:	Research
Date Submitted by the Author:	24-Mar-2017
Complete List of Authors:	Kastor, Anshul; International Institute for Population Sciences, Fertility Studies Mohanty, Sanjay; INTERNATIONAL INSTITUTE FOR POPULATION SCIENCES, DEPARTMENT OF FERTILITY STUDIES
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	Disease and Age-pattern, Hospitalization, Cost of Treatment, Non-communicable Diseases, India

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Title:

**Disease and Age Pattern of Hospitalization and Cost of Treatment in India:
1995-2014**

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Abstract

Objectives: The early onset of non-communicable diseases (NCDs) resulting from epidemiological transition coupled with demographic transition is affecting the working adults and the elderly equally and has become the major cause of mortality and morbidity in India. This may result into a huge financial burden for government as well as for households. In this context, this paper examines the diseases and age pattern of hospitalization and cost of treatment in India during 1995-2014.

Design: The present study used the nationally representative data on morbidity and health from the 52nd (1995) and 71st (2014) rounds of the National Sample Survey.

Settings: A total of 120,942 households and 629,888 individuals were covered in 1995, and 65,932 households and 333,104 individuals were surveyed in 2014.

Measures: The hospitalization rate and cost of treatment were estimated for selected diseases and in four broad categories- communicable diseases, NCDs, injuries and others.

Results: The hospitalization rate has increased from 1661 in 1995 to 3699 in 2014 (per 100000 population). Increase in hospitalization has more than doubled across all age groups. Hospitalization among children was primarily because of communicable diseases, while NCDs were the leading cause of hospitalization for those above 40+ age. The mean cost of hospitalization has increased from Rs.11165 in 1995 to Rs.20373 (increased by 83%) in 2014. The mean cost of hospitalization for NCDs in 2014 was Rs.30661 compared to Rs.11055 for communicable diseases. The highest cost of hospitalization was reported by cancer patients (Rs.62349) followed by heart diseases (Rs.43243). Age is the significant predictor of hospitalization for all of the selected diseases.

Conclusion: The increased public spending on health has a direct effect in reducing the out-of-pocket health expenditure (OOPHE) on these diseases and could be helpful for many households to overcome the medical poverty trap.

Strengths and limitations of this study

- This study provides disease specific hospitalization rates in a more comprehensive manner than ever using 11 age-groups.
- Change in disease specific cost of hospitalization has been estimated over past two decades.
- Study only uses the hospitalization cost which underestimates the total financial burden incurred by households on health care.

Introduction

Demographic transition and epidemiological transition have altered the age pattern of mortality and morbidity globally and nationally. While there has been significant progress in the reduction of infant and child mortality, adult mortality has shown varying patterns across regions and countries and deaths are postponed to progressively older ages[1-2]. Non-communicable diseases (NCDs) are now the leading cause of mortality, hospitalization and disability in both developed and developing countries[3-4]. Social, economic and human loss due to the changing disease pattern is profound, which is affecting economic growth and development across countries significantly[5-6].

The human capital models are based on the premise that health depreciates with age and can be augmented by investing in health including medical care[7]. Medical care is significantly

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3 associated with income, educational attainment, accessibility and availability of health
4 services and the share of elderly population[8-11]. Increasing medical care is also driving the
5 costs and treating non-communicable diseases is becoming expensive. While health care is
6 largely inelastic in nature, medical spending is catastrophic to large households and
7 families[12-20]. Publically funded health programmes are covering primary health services
8 but are not equipped to meet the challenge of growing non-communicable diseases.
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11 Demographic change in India is marked with three key developments - falling fertility in the
12 states, increase in longevity across age and improvement in child survival among
13 socioeconomic groups. While the country is nearing to the replacement level of fertility,
14 increase in longevity has been experienced across all age groups. Life expectancy at birth has
15 increased from 59.4 years in 1991 to 66.1 years in 2011[21]. Under-five mortality has
16 reduced by more than half during the same period and is estimated at 55 per 1000 live
17 births[22]. These positive developments are accompanied with a changing disease pattern
18 (increase in non-communicable diseases and injuries). The NCDs have become the leading
19 cause of mortality, disability and morbidity in India[23] and are projected to increase in the
20 coming years[24].
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23 Evidence suggests that household health spending accounts for 71% of total health
24 spending[25] and household health spending is catastrophic to a large number of households.
25 Hospitalization accounts for a large share of medical spending and the pattern of
26 hospitalization varies across age. Also the growth rate of household health spending is faster
27 than the growth rate of household income[26]. Though some attempt has been made to
28 address the morbidity and disease pattern in India, the age pattern of hospitalization and
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associated costs have not been dealt with. The aim of this paper is to examine the trends in the age pattern of hospitalization and associated costs of treating selected diseases in India.

Methods

Data

The unit data from Schedule 25.0 of the 52nd (1995-96) and 71st rounds (2014) of the National Sample Survey (NSS) conducted by the National Sample Survey Organization (NSSO), Government of India are used in the analyses. These rounds of surveys are the only data bases that provide comprehensive and comparable information on the morbidity pattern and health care utilization among the general population in India. A total of 120,942 households and 629,888 individuals were covered in 1995, and 65,932 households and 333,104 individuals were covered in 2014. The survey covered all states and union territories and the households were selected using multi-stage stratified sampling procedure. The details of the sampling designs and the survey findings are available in the reports of the respective rounds[27-28]. The schedule 25.0 of these two rounds had detailed information on types of ailment, duration of ailment, health care utilization, hospitalization, source of treatment (public/private) and expenditure incurred by each member of the sampled households on treatment of diseases/hospitalization. Data on medical expenditure on medicines, surgery, diagnostic tests, doctor’s fees and lodging charges (direct expenditure) and expenditure on transport charges, and other charges indirect/non-medical expenses are available in both rounds of survey. Our estimates on the cost of hospitalization include all direct and indirect expenditure by household members.

Data on hospitalization (defined as overnight stay in the hospital anytime) were collected in a reference period of 365 days and for out-patients (visit to a health care professional/health

centre and not stayed overnight) in a reference period of fifteen days. We have used only the hospitalization cases because these have the advantage of being medically diagnosed and provided treatment. The number of hospitalized cases were 26,526 in 1995 and 42,869 in 2014. To compare the cost of hospitalization over time, the expenditure is first adjusted to uniform base year (1987-88) and then adjusted at constant prices (2014 prices). The price deflator for rural (agricultural worker) and urban areas (industrial worker) are used as in NSS. All the estimates are presented at 2014 prices[29].

Analytical Approach

For analytical purposes, we have classified the morbidities to four broad categories, namely, communicable diseases, non-communicable diseases, injuries and other diseases similar to the classification of Cause of Death, India 2001-03[25]. Communicable diseases include all types of fever, filariasis, tetanus, diarrhoea, jaundice, respiratory diseases, anaemia, tuberculosis, HIV/AIDS and other sexually transmitted diseases, whereas non-communicable diseases include cancer, diabetes, heart diseases, hypertension, asthma, musculoskeletal, genito-urinary, psychiatric and neurological illnesses. Disease specific analyses have been carried out by considering the frequencies and the importance of the disease. The specific diseases used are fever, diarrhoea, tuberculosis, cancer, heart diseases, hypertension, diabetes and injuries. There are eleven broad age-groups, namely, <1, 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+. The analyses have been limited to the national level.

Hospitalization rate, descriptive statistics and logistic regression analyses are used in the analyses. Hospitalization rate is defined as the number of spells of hospitalization anytime during the one year preceding the survey of the population exposed to the risk[30].

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$$\text{Hospitalization Rate} = \frac{\text{Total Number of Spells of Hospitalization during last 365 days}}{\text{Population Exposed to the Risk}} * 100000$$

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The hospitalization rate is expressed per 100,000 population. Mean cost of hospitalization by diseases and age group are presented over time. Bivariate analyses were carried out to understand the differential and variation in hospitalization and associated cost over time. To understand the role of age pattern and cost, a set of logistic regression analyses were carried out. The dependent variables used are hospitalization for specific diseases or group of morbidities and the independent variables used are age-group, sex, place of residence (rural-urban), education, wealth quintile, state (classified based on crude birth rate).

Results

Age pattern of mortality and hospitalization in India has been presented in Figure 1 and 2 respectively. While the age pattern of mortality is borrowed from cause of death report, India 2001-03, the age pattern of hospitalization for 2014 has been estimated from NSS data. In general, the age pattern of mortality and hospitalization by disease are similar in India. For children below 15 years of age, communicable diseases are the leading cause of death and hospitalization. Injury is the leading cause of death for those in the age group 25-34, while communicable diseases are the leading cause of hospitalization. NCDs are the leading cause of death and hospitalization in India for those who are 35+ ages.

[Fig 1 to be embedded here]

[Fig 2 to be embedded here]

Table 1 presents the profile of the households and individuals surveyed in 1995-96 and in 2014. The mean age of population has increased by four years, while the average household size has declined by 0.7 persons over the last two decades. The proportion of children (0-14 years) has declined, while that of elderly population has increased. Educational attainment has improved over time. The monthly per capita consumption expenditure (MPCE), an indicator of household economic well-being, has increased by 37% (at 2014 constant price). However, rural-urban differences in MPCE have remained large over time.

Table 1: Sampling profile of individuals and households in India, 1995-2014

Variable	1995-96	2014
Mean Age (in years)	25.0	28.5
Sex Ratio (Females per 1000 Males)	939	943
Urbanization (%)	24.2	30.0%
Average Household Size	6.23	5.54
Age distribution (%)		
Child Population (0-14)	36.8	29.0
Working Age (15-59)	57.7	63.2
Elderly (60+)	5.5	7.8
Education level		
No Education	48.9	31.5
Primary	29.0	30.3
Secondary	16.4	23.9
Higher Secondary	5.7	14.3
Average Monthly Per Capita Consumption Expenditure (in Rs.)	1185	1625
Average Monthly Per Capita Consumption Expenditure (Rural)	984	1287
Average Monthly Per Capita Consumption Expenditure (Urban)	1814	2414
Number of Households	120942	65932
Number of persons	629888	333104

[Fig 3 to be embedded here]

Fig 3 presents the hospitalization rate in 1995 and 2014 across broad age groups in India. The age pattern of hospitalization rate has shifted upward over time. The overall hospitalization rate (per 100,000 population) has increased more than twice, from 1661 in 1995-96 to 3699 in 2014. The hospitalization rates of infants (<1 years age) had increased thrice during the period, lowest in the age group 5-9 and lower till age 30. Beyond age 40, the hospitalization rate has increased at a faster rate and by age 80, the hospitalization rate was about five times higher than that of the overall population. Barring infants, the hospitalization rate is an increasing function of age at both time periods.

[Fig 4 to be embedded here]

During 1995-2014, the hospitalization rates for communicable diseases increased by 47% (from 958 in 1995-96 to 1412 in 2014) and by 137% for non-communicable diseases (482 to 1142) (Table 2). The age pattern of hospitalization rates of communicable and non-communicable diseases has shown an interesting trend (Fig 4). In 1995, hospitalization due to communicable diseases was higher than the NCDs in eight of the eleven specified age groups (except 50-59, 70-79 and 80+). By 2014, hospitalization due to NCDs was higher in five of the eleven specified age groups (higher for all ages beyond 40). This suggests that NCDs are now advancing and affecting the younger age group. The hospitalization of communicable diseases has shown “U” shaped curve in both the periods and the curve has shifted over time suggesting increasing hospitalization (Fig 4). Hospitalization of communicable diseases has increased among the children and elderly and was highest among infants. Hospitalization beyond age 40 was primarily due to NCDs. Hospitalization due to injuries had also increased across all age groups and showed an increasing pattern (Fig 5). Further, hospitalization due to other diseases has also increased over time especially due to senility among the elderly.

Table 2: Age pattern of hospitalization rate (per 100000 population) by communicable disease, non-communicable diseases, injuries and other diseases in India, 1995-2014

Age	Hospitalization Rate per 100000 Population										Percentage Change (1995-2014)				
	Communicable Disease		Non-Communicable Disease		Injuries		Senility/ Other Diseases		All Diseases		Communicable Disease	Non-Communicable Disease	Injuries	Senility/ Other Diseases	All Disease
	1995-96	2014	1995-96	2014	1995-96	2014	1995-96	2014	1995-96	2014					
<1	1496	4594	123	372	18	180	107	285	1745	5431	207	201	893	165	211
1-4	1087	2108	150	309	40	206	28	283	1306	2907	94	106	411	915	123
5-9	410	853	114	202	57	205	30	158	610	1418	108	78	262	423	132
10-19	595	799	175	227	79	384	32	236	881	1646	34	30	386	633	87
20-29	1079	1466	347	486	109	449	47	399	1583	2799	36	40	312	741	77
30-39	1004	1205	469	940	149	514	71	542	1692	3201	20	100	246	660	89
40-49	1093	1254	863	1713	174	728	116	884	2246	4579	15	98	318	662	104
50-59	1370	1601	1161	2346	198	836	237	1155	2965	5938	17	102	323	387	100
60-69	1706	2214	1726	3961	240	910	549	2131	4221	9217	30	130	279	288	118
70-79	2036	2931	2662	6816	325	1089	789	2543	5811	13379	44	156	235	223	130
80+	2744	4299	2235	7829	462	1976	1804	2362	7245	16466	57	250	328	31	127
All Ages	958	1412	482	1141	116	517	106	629	1661	3699	47	137	346	496	123

[Fig 5 to be embedded here]

Table 3 presents the hospitalization rates (per 100,000 population) of fever, diarrhoea and tuberculosis in 1995-96 and 2014. Hospitalisation due to fever has increased for all age groups and has not shown any pattern with age in both the periods. The increase in hospitalization was similar for all age groups. In 2014, hospitalization due to fever was highest for the 80+ age group (1169) followed by children in the 1-4 age group (1157). During 1995-2014, hospitalization due to diarrhoea had decreased from 159 to 124. Hospitalization for diarrhoea had declined for all the age-groups except children under five years. In 2014, hospitalization due to diarrhoea was highest for infants followed by children in the 1-4 age group. Similarly, there was a modest increase in hospitalization due to tuberculosis (from 41 to 50) and this increase was minimal among all hospitalization cases. The age pattern of tuberculosis suggests a decreasing trend across all ages beyond 30, while it has shown an increasing pattern for the age group below 30 years. Hospitalization due to injury has widened sharply over time and across all ages suggesting a positive association between age and injuries.

Table 4 presents the hospitalization rate due to four specific non-communicable diseases, namely, heart diseases, hypertension, diabetes and cancer. Hospitalization due to cancer, heart diseases, hypertension and diabetes has increased more than threefold during the same period. Hospitalization due to these four NCDs is positively associated with age. Hospitalization due to each of these four diseases has increased for each specified age group. The increase is equally high among the working age group (30-69) suggesting that it is significantly affecting the working population. In 1995, the hospitalization rates of cancer (187) and heart diseases (577) was highest in the age group 70-79 and in 2014 it was highest

among the 80+ (626 and 3402 respectively). Hospitalization rates for hypertension (954) and diabetes (614) were highest among those in the 70-79 age group.

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Table 3: Age pattern of hospitalization rate (per 100000 population) by fever, diarrhoea, tuberculosis and injuries in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population								Percentage Change (1995-2014)			
	Fever		diarrhoea		Tuberculosis		Injury		Fever	Diarrhoea	Tuberculosis	Injury
	1995	2014	1995	2014	1995-96	2014	1995-96	2014				
<1	260	864	213	425	5	0	18	185	233	100	-100	920
1-4	306	1157	364	421	9	40	40	207	278	16	351	413
5-9	124	578	109	79	7	14	57	207	366	-28	91	265
10-19	187	512	91	45	12	24	79	385	174	-51	109	388
20-29	204	544	102	63	33	45	109	456	166	-38	33	318
30-39	196	549	142	97	64	35	149	521	181	-31	-46	250
40-49	190	593	170	82	68	83	174	737	212	-52	20	323
50-59	263	868	221	150	97	89	198	839	230	-32	-8	325
60-69	312	940	206	214	143	89	240	913	201	4	-37	281
70-79	307	928	339	311	121	81	325	1110	202	-8	-33	242
80+	338	1169	716	399	108	584	462	2236	246	-44	443	384
All Ages	208	659	159	124	41	50	116	523	216	-22	24	352

Table 4: Age pattern of hospitalization rate (per 100000 population) by heart diseases, hypertension, diabetes and cancer in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population								Percentage Change (1995-2014)			
	Heart Disease		Hypertension		Diabetes		Cancer		Heart Diseases	Hypertension	Diabetes	Cancer
	1995	2014	1995	2014	1995	2014	1995	2014				
<30	21	44	3	11	1	7	7	16	110	267	600	129
30-39	39	129	16	43	4	27	27	70	233	166	543	157
40-49	156	402	63	170	30	88	61	142	158	171	198	131
50-59	284	664	133	285	60	193	67	216	134	115	224	224
60-69	331	1280	202	479	119	378	127	407	287	137	216	221
70-79	577	2493	223	954	245	614	187	283	332	328	150	51
80+	309	3402	253	836	34	562	81	626	1002	231	1561	673
All Ages	78	295	32	110	17	73	28	87	276	239	331	216

Cost of Hospitalization in Treating Communicable and Non-Communicable Diseases

Figure 6 shows the mean cost of treatment for communicable diseases, NCDs, injuries and other diseases in 1995-96 and 2014. Expectedly, NCDs had the highest cost of treatment compared to all other specified categories during both the surveys. The mean cost of treatment of NCDs (Rs.30661) was about three times higher than that of communicable diseases (Rs.11055) in both the periods. Noticeably, the expenditure on injuries is also very high (Rs.27446). During 1995-2014, the mean cost of treatment for communicable diseases had increased by 77%, while that of communicable diseases had increased by 55% at constant prices. Both communicable and NCDs did not show any pattern in cost of treatment with respect to age.

[Fig 6 to be embedded here]

[Fig 7 to be embedded here]

Table 5 presents the mean cost of hospitalization by public and private hospitals for each specified disease at 2014 prices. In 2014, the mean cost of treating cancer was most expensive (Rs.62349) followed by heart disease (Rs.29242) (Fig 7). The pattern holds true for both public and private health centres. The cost of treating diarrhoea was lowest followed by fever. The cost of treatment of each of the diseases in private health centres was about two to three times higher than that in public health centres in both periods. The cost of treatment of specified diseases has increased over time - increase of 113% for cancer, 23% for heart disease, 41% for hypertension and 27% for diabetes. While the increase in cost of treatment was highest for cancer, it was lowest for tuberculosis. It may be noted that the mean cost of treatment

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Table 5: Mean cost of treatment in public and private health centers by disease in India, 1995-2014

	Change in Mean Cost of Treatment by Public-Private Expenditure during 1995-2014								
Diseases	1995			2014			% Change (1995-2014)		
	Public	Private	Total	Public	Private	Total	Public	Private	Total
Communicable Diseases	4115	8809	6263	4513	15927	11055	9.7	80.8	76.5
NCDs	12327	25551	19755	12756	39783	30661	3.5	55.7	55.2
Injuries	11461	21043	15688	10349	39450	27446	-9.7	87.5	74.9
Fever	2736	4738	3777	3185	11966	8711	16.4	152.6	130.6
Diarrhoea	1966	5380	3417	2219	9766	5640	12.9	81.5	65.1
Tuberculosis	8304	17375	11422	6692	24178	13121	-19.4	39.1	14.9
Heart Diseases	13766	50517	35273	15837	58605	43243	15.0	16.0	22.6
Hypertension	6762	13111	10555	4175	21354	14842	-38.3	62.9	40.6
Diabetes	8126	15660	12368	5797	20404	15768	-28.7	30.3	27.5
Cancer	18840	47944	29242	29131	84321	62349	54.6	75.9	113.2
All Diseases	7227	15434	11165	7803	28158	20373	8.0	82.4	82.5

hospitals has declined for hypertension, diabetes, tuberculosis and injuries. The cost of hospitalization was not only expensive in private health centres but also recorded a faster increase for each of the diseases. The faster increase in the cost of hospitalization in private health centres had increased the gap between public-private expenditure over time. For example, in 1995-96, the treatment cost of communicable diseases at private hospitals was twice that in public hospitals (Rs.8809 and Rs.4115 respectively), whereas the difference increased to 3.5 times (Rs.15927 and Rs.4513 respectively) in 2014. Similarly, in 1995-96, the treatment cost of NCDs at private hospitals was twice that in public hospitals (Rs.25551 and Rs.12327 respectively), whereas the difference increased threefold (Rs.39783 and Rs.12756 respectively) in 2014.

Multivariate Analyses

Table 6 presents the odds of hospitalization for communicable diseases, NCDs and injuries and their confidence interval. Hospitalization for a specific category of disease (for instance, communicable diseases) was taken as 1 and 0 for hospitalization of all other diseases. The set of explanatory variables are age, sex, place of residence, educational attainment, MPCE quintile and the level of crude birth rate (CBR) of the state. Estimates were obtained for 1995 and 2014 and presented for 2014 because the patterns were similar over time. Age, sex and place of residence are significant predictors of communicable diseases. With respect to age, we have taken 30-39 as the reference group because the NCDs increase from this age group at a faster pace. Hospitalization for communicable diseases is significantly higher among the younger age group compared to the older age group and the odds of hospitalization decrease with age. For example, the odds of hospitalization among children in the age group 1-4 were six times higher than those in the 30-39 age group. Compared to males, females were significantly more likely to be hospitalized for

Table 6: Results of logistic regression for hospitalization due to communicable, non-communicable diseases and injuries in India, 2014

Covariates	Odds Ratio, CI and significance level		
	Communicable Diseases Dependent variable (1-Yes, 0-N0)	NCDs	Injuries
Age-Group			
<1	13.04***(10.66-15.96)	0.16***(0.12-0.21)	0.15***(0.10-0.21)
1-4	5.65***(5.02-6.37)	0.27***(0.23-0.32)	0.35***(0.29-0.42)
5-9	3.06***(2.72-3.45)	0.39***(0.33-0.45)	0.74***(0.63-0.87)
10-19	1.82***(1.66-1.98)	0.45***(0.40-0.50)	1.08(0.97-1.21)
20-29	1.74***(1.61-1.88)	0.57***(0.52-0.62)	1.06(0.95-1.17)
30-39®			
40-49	0.70***(0.64-0.76)	1.40***(1.30-1.52)	0.91*(0.82-1.01)
50-59	0.61***(0.56-0.66)	1.64***(1.52-1.78)	0.75***(0.67-0.83)
60-69	0.54***(0.49-0.59)	2.00***(1.84-2.18)	0.49***(0.44-0.56)
70-79	0.57***(0.51-0.63)	2.06***(1.86-2.28)	0.49***(0.43-0.57)
80+	0.73***(0.62-0.85)	1.98***(1.71-2.28)	0.66***(0.54-0.81)
Sex			
Male®			
Female	1.38***(1.32-1.45)	1.06**(1.01-1.11)	0.46***(0.43-0.49)
Place of Residence			
Rural®			
Urban	0.94***(0.90-0.99)	1.21*** (1.16-1.27)	0.86*** (0.81-0.91)
Education Level			
No Education®			
Primary	1.06*(0.99-1.13)	0.96(0.90-1.02)	0.96(0.88-1.04)
Secondary	1.03(0.96-1.10)	0.92** (0.86-0.99)	1.04(0.96-1.14)
Higher Secondary	1.04(0.96-1.13)	0.80*** (0.74-0.88)	1.09(0.98-1.20)
MPCE			
Poorest®			
Poorer	1.01(0.94-1.08)	0.98(0.91-1.05)	1.02(0.93-1.12)
Middle	0.98(0.92-1.05)	1.03(0.96-1.11)	1.00(0.92-1.10)
Richer	1.05(0.98-1.13)	1.02(0.95-1.10)	0.973(0.88-1.07)
Richest	1.03(0.95-1.11)	1.11** (1.03-1.20)	0.96(0.87-1.06)
State CBR			
CBR<18®			
18-23	1.26*** (1.19-1.34)	0.99(0.93-1.05)	0.81*** (0.75-0.88)
CBR>23	1.04(0.99-1.10)	0.90*** (0.85-0.95)	1.01(0.94-1.08)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

communicable diseases. Age, sex, place of residence and educational attainment are significant predictors of NCDs. The odds of hospitalization for NCDs are lower than the

reference age group for all ages below 30 and higher for all age groups above 40. The odds of hospitalization increase with age, that is, beyond age 40 - 1.4 for the age group 40-49, 1.69 for 50-59 and 2.0 for 60-69. Females and urban residents are significantly more likely to be hospitalized for NCDs. Age pattern of hospitalization of injuries is distinct; it significantly affects those in the age group 30-39 and is lower for all other age groups. The odds of hospitalization decrease with age beyond the reference age group. Females are significantly less likely to be hospitalised for injuries compared to males.

Table 7 presents the odds ratio and confidence interval for three specific diseases, namely, fever, diarrhoea and tuberculosis. The odds of hospitalization for fever and diarrhoea were higher for the younger age group and lower for older age group. While most of the age groups were significant in the case of fever, older age groups (40+) were not significant for diarrhoea. Females are significantly more likely to be hospitalized for fever and diarrhoea. The odds of hospitalization for fever increase with MPCE quintile and decrease in the case of diarrhoea. In the case of tuberculosis, hospitalization for the older age group is not statistically significant; those in the younger age groups are less likely to be hospitalized compared to those in the 30-39 age group. The odds of hospitalization for females and urban residents are significantly lower compared to males and rural

Table 7: Results of logistic regression for hospitalization of fever, diarrhoea and tuberculosis in India 2014

Covariates	Odds Ratio		
	Fever	Diarrhoea	Tuberculosis
Age-Group			
<1	1.80***(1.41-2.30)	4.66***(3.34-6.52)	
1-4	2.40***(2.08-2.77)	4.99***(3.98-6.25)	0.25***(0.15-0.43)
5-9	2.53***(2.17-2.94)	2.29***(1.79-2.93)	0.32***(0.18-0.58)
10-19	2.10***(1.86-2.37)	1.28**(1.02-1.60)	0.68**(0.47-1.00)
20-29	1.37***(1.22-1.54)	0.98(0.77-1.24)	1.28(0.91-1.78)
30-39®			
40-49	0.70***(0.62-0.78)	0.81*(0.64-1.02)	1.23(0.90-1.68)
50-59	0.57***(0.50-0.64)	0.85(0.67-1.07)	0.82(0.58-1.14)
60-69	0.35***(0.30-0.40)	1.00(0.79-1.27)	0.92(0.65-1.30)
70-79	0.29***(0.24-0.34)	0.81(0.60-1.10)	0.55**(0.34-0.89)
80+	0.27***(0.21-0.35)	0.75(0.48-1.16)	1.30(0.79-2.13)
Sex			
Male®			
Female	1.36***(1.28-1.45)	1.25***(1.13-1.39)	0.65***(0.54-0.79)
Place of Residence			
Rural		0.97(0.87-1.07)	
Urban	0.95(0.89-1.01)		0.58***(0.48-0.70)
Education Level			
No Education®			
Primary	1.08*(0.99-1.19)	0.99(0.85-1.17)	0.76**(0.60-0.96)
Secondary	0.99(0.90-1.10)	1.02(0.85-1.23)	0.67***(0.52-0.87)
Higher Secondary	1.04(0.92-1.17)	1.06(0.85-1.34)	0.52***(0.37-0.73)
MPCE			
Poorest®			
Poorer	1.10**(1.01-1.22)	1.12(0.97-1.29)	0.67***(0.52-0.86)
Middle	1.15***(1.05-1.26)	0.99(0.85-1.15)	0.68***(0.53-0.88)
Richer	1.33***(1.20-1.46)	0.75***(0.63-0.89)	0.74**(0.57-0.97)
Richest	1.20***(1.08-1.34)	0.70***(0.58-0.85)	0.55***(0.40-0.75)
State CBR			
CBR<18®			
18-23	1.37***(1.26-1.48)	1.16**(1.01-1.33)	0.99(0.76-1.28)
CBR>23	0.85***(0.79-0.92)	1.12*(0.99-1.26)	1.92***(1.58-2.34)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

respectively. The odds of hospitalization for tuberculosis decrease with educational attainment and MPCE quintile except for the richer quintile. The odds of hospitalization for tuberculosis in high fertility states are twice higher than that in low fertility states.

Table 8 presents the odds ratio for hospitalization of heart diseases, hypertension, diabetes and cancer. The odds of being hospitalized were significantly lower among those aged below 30 for all the selected diseases. The chances of hospitalization for heart diseases, hypertension and diabetes increases with age, while hospitalization due to cancer was significantly lower among those aged 70+ compared to the reference category.

Females had lower odds of hospitalization due to heart diseases whilst they had higher chances of being hospitalized due to hypertension, diabetes and cancer. The odds of hospitalization due to diabetes (40%) and cancer (35%) was higher among the richest than those in the poorest MPCE quintile. The chances of hospitalization for heart diseases were significantly lower in high fertility states.

Table 8: Results of logistic regression for hospitalization of heart diseases, hypertension, diabetes and cancer in India 2014

Covariates	Odds Ratio			
	Heart Diseases	Hypertension	Diabetes	Cancer
Age-Group				
<30	0.45***(0.37-0.53)	0.24***(1.16-0.34)	0.26***(0.17-0.40)	0.33***(0.25-0.43)
30-39®				
40-49	1.76***(1.49-2.10)	1.96***(1.46-2.62)	2.32***(1.68-3.21)	1.23(0.96-1.58)
50-59	2.63***(2.23-3.10)	2.88***(2.18-3.81)	3.74***(2.75-5.10)	0.95(0.73-1.22)
60-69	3.58***(3.03-4.24)	3.65***(2.75-4.85)	4.30***(3.14-5.89)	1.09(0.84-1.41)
70-79	4.21***(3.51-5.05)	4.01***(2.96-5.44)	3.74***(2.65-5.28)	0.46***(0.32-0.67)
80+	3.80***(3.02-4.77)	4.00***(2.76-5.78)	3.04***(1.97-4.69)	0.25***(0.13-0.49)
Sex				
Male®				
Female	0.87***(0.80-0.95)	1.21***(1.05-1.39)	1.45***(1.25-1.68)	2.14***(1.83-2.50)
Place of Residence				
Rural®				
Urban	1.31***(1.20-1.43)	1.56***(1.35-1.80)	1.40***(1.20-1.63)	0.95(0.81-1.12)
Education Level				
No Education				
Primary	1.01(0.90-1.12)	1.02(0.85-1.22)	1.11(0.92-1.34)	1.06(0.87-1.30)
Secondary	1.03(0.91-1.16)	1.05(0.86-1.28)	1.12(0.91-1.37)	0.76**(0.61-0.95)
Higher Secondary	0.96(0.83-1.10)	1.07(0.84-1.37)	0.99(0.76-1.28)	1.11(0.88-1.42)
MPCE				
Poorest®				
Poorer	0.92(0.80-1.06)	0.85(0.67-1.07)	1.10(0.86-1.42)	0.90(0.68-1.19)
Middle	0.96(0.84-1.10)	1.12(0.91-1.39)	1.23*(0.97-1.56)	1.08(0.84-1.40)
Richer	0.93(0.81-1.06)	1.09(0.88-1.36)	1.20(0.93-1.53)	1.15(0.89-1.49)
Richest	0.90(0.78-1.03)	0.98(0.77-1.24)	1.40***(1.09-1.80)	1.35**(1.05-1.74)
State CBR				
CBR<18®				
18-23	0.84***(0.75-0.93)	1.26***(1.06-1.49)	0.95(0.79-1.14)	1.03(0.84-1.26)
CBR>23	0.76***(0.68-0.84)	0.94(0.79-1.11)	0.90(0.75-1.08)	1.20**(1.00-1.43)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Discussion

Demographic change during the last two decades has significantly altered the age structure of India’s population. The size and share of the working population and elderly is growing exponentially. This age-structural transition is not merely associated with demographic transition but is also linked to the epidemiological transition, that is, the transition of disease

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2
3 pattern from communicable to non-communicable diseases. The early onset of non-
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5 communicable diseases (NCD) resulting from epidemiological transition is affecting working
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7 adults and the elderly equally and has become the leading cause of mortality and morbidity.
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9 Further, epidemiological transition not only increases the burden of diseases in a country but
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11 also imposes high financial hardship on its government and households. In this context, we
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13 examined the age pattern of hospitalization and cost of treatment in India during last two
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15 decades. We have used the two rounds of NSS survey data (52nd and 71st round). The 71st
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17 round of NSS data is the most recent concluded survey on morbidity and health care in India.
18
19 The following are salient findings from our analysis.
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21

22
23 First, the age pattern of hospitalisation is similar to that of mortality, alike mortality, NCDs
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25 are the leading cause of hospitalisation in India. Barring infant, the hospitalisation is an
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27 increasing function of age and recorded exponential growth beyond age 40 years. The
28
29 hospitalization rate has been more than doubled during 1995 to 2014 across all the age-
30
31 groups and the increase was more prominent for infants, children and those 60 years and
32
33 above. This increased hospitalisation may be attributed to an array of factors; rising
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35 morbidity over time, awareness on health benefit of the population, increasing income of the
36
37 population, availability and accessibility of health services, etc. Second, hospitalization due
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39 to communicable diseases, non-communicable and injuries has increased over time
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41 confirming the triple burden of diseases in India[24]. The hospitalization among children was
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43 primarily because of communicable disease whereas the NCDs are the leading cause of
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45 hospitalization beyond 40+ ages. The hospitalization due to heart diseases, hypertension,
46
47 diabetes and cancer have more than tripled during the same period. Third, the increasing
48
49 hospitalization is associated with increasing cost over time irrespective of the diseases.
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51 However, the cost of hospitalization was maximum among cancer patients. Fourth, the cost of
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53 treatment of NCDs was three times higher compared to the communicable diseases. Besides,
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the cost of treatment in private health care facilities was significantly higher than public hospitals. Other studies have documented that the share of NCDs in out-of-pocket health expenditure incurred by households increased over time in India[6] and the cost of NCDs are expected to increase faster in coming years[24]. Many studies have shown that the high out-of-pocket health expenditure is catastrophic and impoverishment impact in general and for poor households in particular and push many families to medical poverty trap[12, 17, 19, 31, 32].

Conclusion: Rate of hospitalization has more than doubled during last two decades across all age-groups. Mean cost of hospitalization was also doubled over time. Further, mean cost of hospitalization for NCDs was three times higher than communicable diseases in 2014 consequently, imposing high financial burden to the families. Though the catastrophic and impoverishment effect of out-of-pocket health expenditure was out of purview of this study but many poor families are pushed into poverty due to the high treatment cost. The increased public spending on health has a direct effect in reducing the out-of-pocket health expenditure and could be helpful for many households to overcome the medical poverty trap. The Ministry of Health and Family Welfare, Government of India launched the “National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS)” in 2010. Initially, the programme was implemented in 100 districts covering 21 states and is proposed to be expanded in all the districts across the country with focus on strengthening of infrastructure, human resource development, health promotion, early diagnosis, treatment and referral for prevention and control of cancer, diabetes, cardiovascular diseases and stroke[33]. Expansion of the NPCDCS to all of the districts may be helpful in averting many households from medical poverty trap.

Footnotes

Contributors: AK and SKM have contributed a considerable share of their knowledge and effort. Both the authors (AK and SKM) designed and conceptualized the study. AK analysed

the data and drafted the manuscript. SKM finalized the manuscript and gave critical comments for the study.

Conflict of interest: Authors declare that they have no conflict of interest.

Ethical Treatment of Experimental Subjects (Animal and Human): This article does not contain any studies with human or animal subjects performed by the author.

Informed Consent: The study used the data set that is available online in public domain; hence, there was no need to seek ethical consent to publish this study.

Funding: This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Data sharing and statement: No additional data are available.

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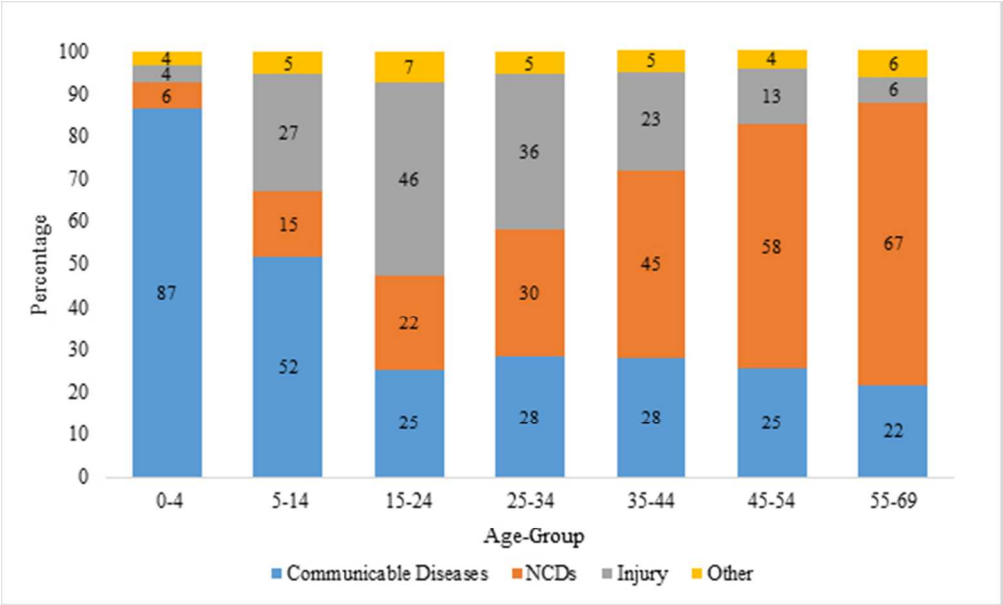


Fig 1: Age pattern of death by cause of death in India, 2001-03

156x180mm (96 x 96 DPI)

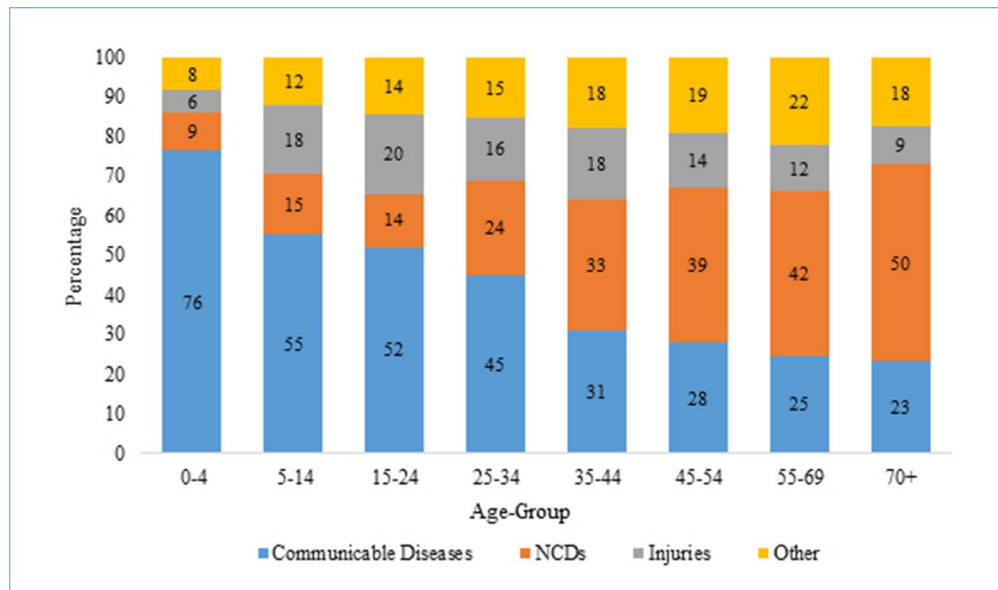


Fig 2: Age pattern of hospitalization in India, 2014

156x180mm (96 x 96 DPI)

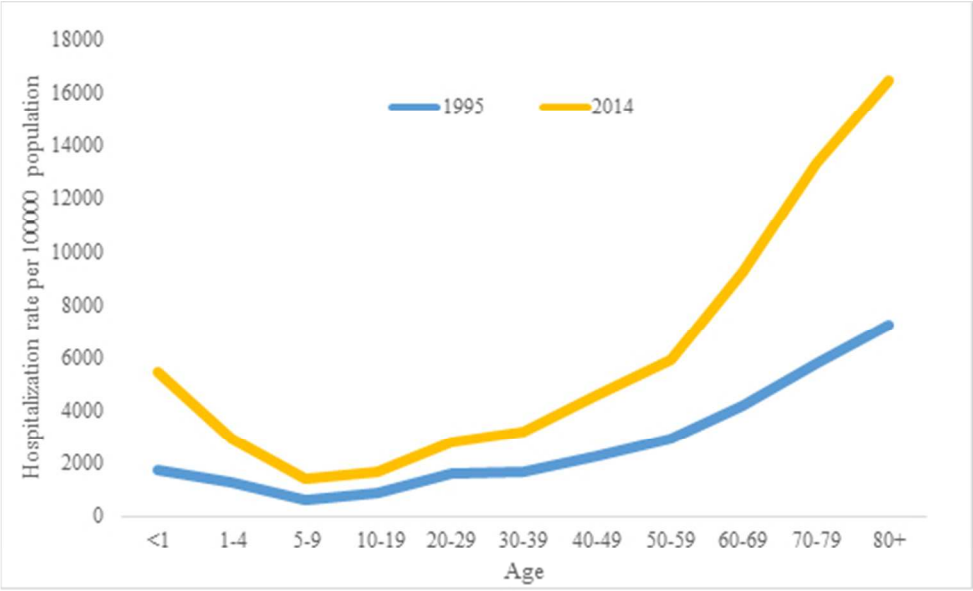


Fig 3: Age pattern of hospitalization in India, 1995-2014

146x180mm (96 x 96 DPI)

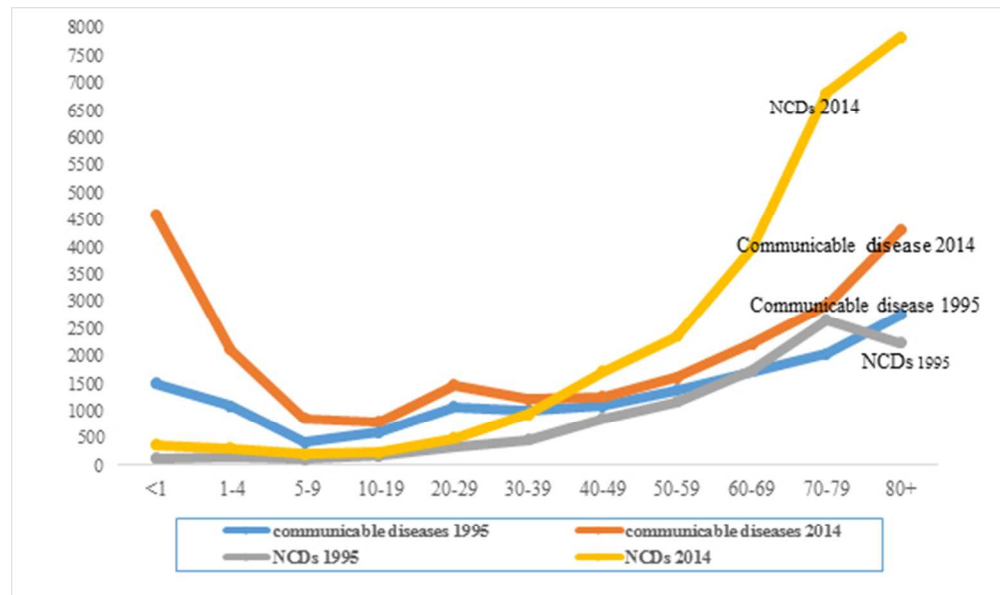


Fig 4: Age Pattern of hospitalization rate (per 100,000 population) of communicable and non-communicable diseases in India: 1995-2014

158x180mm (96 x 96 DPI)

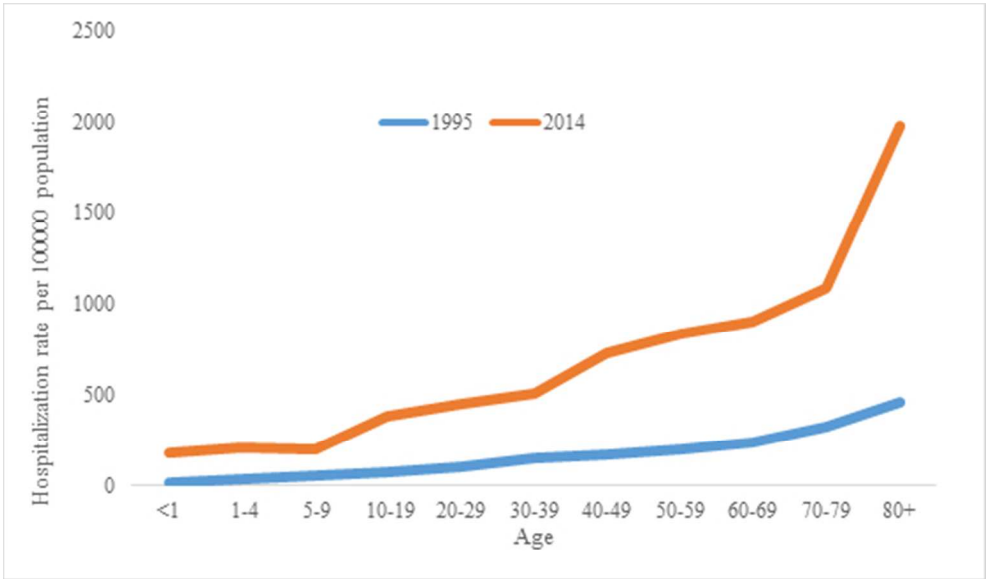


Fig 5: Age pattern of hospitalization rate of injuries in India: 1995-2014

148x180mm (96 x 96 DPI)

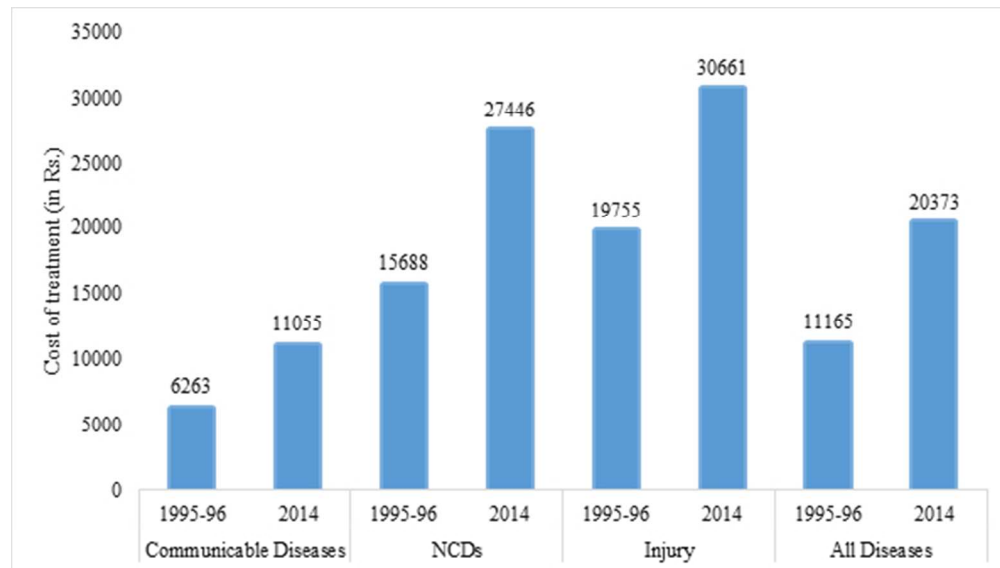


Fig 6: Mean cost of treatment for communicable diseases, NCDs, injuries and other diseases in India (in Indian rupees), 1995-2014

157x180mm (96 x 96 DPI)

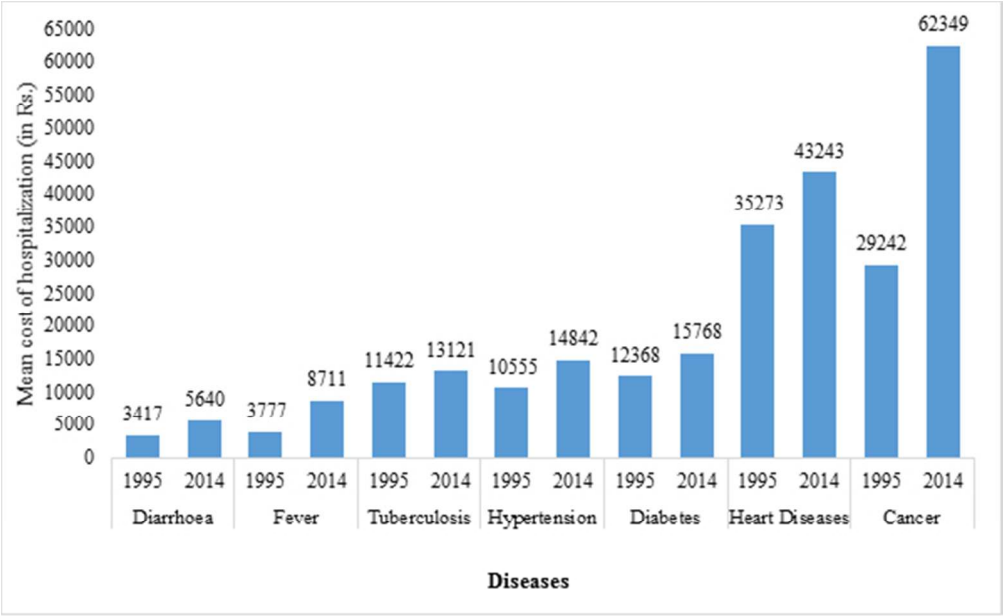


Fig 7: Mean cost of hospitalization (in Indian rupees) by type of diseases in India, 1995-2014

158x180mm (96 x 96 DPI)

BMJ Open

Disease and Age Pattern of Hospitalization and Cost of Treatment in India: 1995-2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016990.R1
Article Type:	Research
Date Submitted by the Author:	08-Aug-2017
Complete List of Authors:	Kastor, Anshul; International Institute for Population Sciences, Fertility Studies Mohanty, Sanjay; INTERNATIONAL INSTITUTE FOR POPULATION SCIENCES, DEPARTMENT OF FERTILITY STUDIES
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	Disease and Age-pattern, Hospitalization, Cost of Treatment, Non-communicable Diseases, India

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Title:

Disease and Age Pattern of Hospitalization and Cost of Treatment in India:
1995-2014

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Abstract

Objectives: The objective of this study is to examine the trends in disease and age pattern of hospitalization and cost of treatment in India during 1995-2014.

Design: The present study used the nationally representative data on morbidity and health care from the 52nd (1995) and 71st (2014) rounds of the National Sample Survey.

Settings: A total of 120,942 households and 629,888 individuals were surveyed in 1995, and 65,932 households and 333,104 individuals in 2014.

Measures: Descriptive statistics, logistic regression analyses and the decomposition analyses were used in examining the changes in patterns of hospitalization and associated costs. The hospitalization rate and cost of treatment (out-of-pocket expenditure) were estimated for selected diseases and in four broad categories- communicable diseases, NCDs, injuries and others. All the costs are presented at 2014 prices in US dollars.

Results: The hospitalization rate in India has increased from 1661 in 1995 to 3699 in 2014 (per 100000 population). Hospitalization rate has more than doubled across all age groups. Hospitalization among children was primarily because of communicable diseases, while NCDs were the leading cause of hospitalization for the 40+ population. The mean cost of hospitalization has increased from US\$ 177 in 1995 to US\$ 316 in 2014 (an increase of 79%). The mean cost of hospitalization for NCDs in 2014 was US\$ 471 compared to US\$ 175 for communicable diseases. The cost of hospitalization was highest for cancer inpatients (US\$ 942) followed by heart diseases (US\$ 674). Age is the significant predictor of hospitalization for all the selected diseases. Decomposition results showed that 39 per cent

increase in the cost of hospitalization was attributed to increase in hospitalization rate and 14 percent due to increase in per capita real cost of hospitalization.

Conclusion: The hospitalization rate has increased more than two folds during the last two decades and the higher rates were observed among infants and older adults. Increased hospitalization and increase in real cost of hospitalization accounts for more than fifty percent of the increase in the total cost of hospitalization in India.

Strengths and limitations of this study

- This study provides disease specific hospitalization rates in a more comprehensive manner than ever using 11 age-groups.
- Change in disease specific cost of hospitalization has been estimated over past two decades.
- It decomposes the increase in total cost of hospitalization by increase in hospitalization rate and per capita real cost of hospitalization.
- Study only uses the hospitalization cost which underestimates the total financial burden incurred by households on health care.

Introduction

Demographic transition and epidemiological transition have altered the age pattern of mortality and morbidity globally and nationally. While there has been significant progress in the reduction of infant and child mortality, adult mortality has shown varying patterns across regions and countries with deaths occurring at progressively older ages[1-2]. Non-communicable diseases (NCDs) are now the leading cause of mortality, hospitalization and

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3 disability in both developed and developing countries[3-4]. Social, economic and human loss
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5 due to the changing disease pattern is profound and affecting economic growth and
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7 development adversely across countries[5-6].
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11 The human capital models are based on the premise that health depreciates with age and can
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13 be augmented by investing in health including medical care[7]. Medical care is positively
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15 associated with income, educational attainment, accessibility and availability of health
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17 services and the share of elderly population[8-11]. Age structural transition (due to
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19 demographic shift), increasing medical care, technological advancement and increase in real
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21 cost of treatment are driving the medical costs exponentially. Medical spending in
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23 developing countries is catastrophic to large households and families[12-20]. Publically
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25 funded health programmes are covering primary health services but are not equipped to meet
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27 the challenge of growing non-communicable diseases.
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33 Demographic change in India is marked with three key developments - falling fertility in the
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35 states, increase in longevity across age and improvement in child survival across
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37 socioeconomic groups. While the country is nearing to the replacement level of fertility,
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39 increase in longevity has been experienced across all age groups. Life expectancy at birth has
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41 increased from 59.4 years in 1991 to 66.1 years in 2011[21]. Under-five mortality has
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43 reduced by more than half during the same period and is estimated at 55 per 1000 live
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45 births[22]. These positive developments are accompanied with a changing disease pattern
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47 (increase share of non-communicable diseases and injuries). The NCDs have become the
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49 leading cause of mortality, disability and morbidity in India[23] and are projected to increase
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51 in the coming years[24].
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Evidence suggests that household health spending in India accounts for 71 per cent of total health spending[25] and is catastrophic to a large number of households. Hospitalization accounts for a large share of medical spending and the pattern of hospitalization varies across age. Besides, the growth rate of household health spending is faster than the growth rate of household economic well-being[26]. Though some attempt has been made to address the morbidity and disease pattern in India, there has been no study on the age pattern of hospitalization and associated costs in India. The aim of this paper is to examine the trends in the age pattern of hospitalization and associated costs of treating selected diseases in India.

Methods

Data

The unit data from Schedule 25.0 of the 52nd (1995-96) and 71st rounds (2014) of the National Sample Survey (NSS) conducted by the National Sample Survey Organization (NSSO), Government of India are used in the analyses. These rounds of surveys are the only data bases that provide comprehensive and comparable information on the morbidity pattern and health care utilization covering the entire population in India. A total of 120,942 households and 629,888 individuals were covered in 1995, and 65,932 households and 333,104 individuals in 2014. The survey covered all states and union territories and the households were selected using multi-stage stratified sampling procedure. The details of the sampling designs and the survey findings are available in the reports of the respective rounds[27-28]. Schedule 25.0 of these two rounds had detailed information on types of ailment, duration of ailment, health care utilization, hospitalization, source of treatment (public/private) and expenditure incurred by each member of the sampled households on treatment of diseases/hospitalization. Data on medical expenditure on medicines, surgery, diagnostic tests, doctor’s fees and lodging charges (direct expenditure) and expenditure on

transport charges, and other charges indirect/non-medical expenses are available in both rounds of survey. Our estimates on the cost of hospitalization include all direct and indirect expenditures incurred by the household members on hospitalization.

Data on hospitalization (defined as overnight stay in the hospital anytime) were collected in a reference period of 365 days and for out-patients (visit to a health care professional/health centre and not overnight stay) in a reference period of fifteen days. We have used only the hospitalization cases because these have the advantage of having been medically diagnosed and provided treatment. The number of hospitalized cases was 26,526 in 1995 and 42,869 in 2014. To compare the cost of hospitalization over time, the expenditure is first adjusted to uniform base year (1987-88) and then adjusted at constant prices (2014 prices)[29]. All the estimates are presented in US Dollars (average exchange rate US\$ 1=INR 60.745) and at 2014 prices. The cost that we referred to in the analysis is the out-of-pocket expenditure that was incurred during hospitalization.

Analytical Approach

For analytical purposes, we have classified the morbidities into four broad categories, namely, communicable diseases, non-communicable diseases, injuries and other diseases similar to the classification of Cause of Death, India 2001-03[25]. Communicable diseases include all types of fever, filariasis, tetanus, diarrhoea, jaundice, respiratory diseases, anaemia, tuberculosis, HIV/AIDS and other sexually transmitted diseases, while non-communicable diseases include cancer, diabetes, heart diseases, hypertension, asthma, musculoskeletal, genito-urinary, psychiatric and neurological illnesses. Disease specific analyses have been carried out by considering the frequencies and the importance of the disease. The specific diseases covered are fever, diarrhoea, tuberculosis, cancer, heart

diseases, hypertension, diabetes and injuries. A total of eleven broad age-groups, namely, <1, 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+ are used in the analysis. The analyses have been limited to the national level.

Hospitalization rate, descriptive statistics, decomposition method and logistic regressions are used in the analyses. Hospitalization rate is defined as the number of spells of hospitalization anytime during the one year preceding the survey of the population exposed to the risk[30].

$$\text{Hospitalization Rate} = \frac{\text{Total Number of Spells of Hospitalization during last 365 days}}{\text{Population Exposed to the Risk}} * 100000$$

The hospitalization rate is expressed per 100,000 population. Mean cost of hospitalization by diseases and age group are presented over time. Bivariate analyses were carried out to understand the differential and variation in hospitalization and associated cost over time.

We have used the decomposition method to understand the role of various factors contribution to the change in total health expenditure (unconditional cost of hospitalization) over time. A detailed description and review of the decomposition method and its underlying assumption can be found elsewhere [31-33].The advantages of using this method is that we can attribute the changes in total cost of hospitalization to the change in rate of hospitalization, age-structure, mean number of times hospitalized and change in per capita cost of hospitalization. A set of multiplicative models is used to estimate and decompose the total health expenditure. The mathematical form of the model is given below.

$$H(t) = \sum_i^n [Ai(t)] * Mi(t) * Ti(t) * Ei(t)----- (1)$$

Where $H(t)$ is the total cost of hospitalization in year “t”

$A_i(t)$ is the number of population in age-group “ i ” in year “ t ”

$M_i(t)$ is the rate of hospitalization of age-group “ i ” in year “ t ”

$T_i(t)$ is the number of times hospitalized of age-group “ i ” in year “ t ”

$E_i(t)$ is the per capita cost of hospitalization in age-group “ i ” in year “ t ”

The models are estimated for unconditional cost of hospitalization for 1995 and 2014. In this method, the effect of one factor can be estimated by varying that factor alone (say rate of hospitalization) and keeping the others constant at initial time (1995). For example, for each age group, the change in cost of hospitalization due to change in rate of hospitalization (let $\Delta M_i(t)$) is computed as:

$$\Delta M_i(t) = \frac{[M_i(t+1) - M_i(t)] * A_i(t) * T_i(t) * E_i(t)}{H_i(t)} \dots\dots\dots (2)$$

Where symbols have the same meaning as in equation (1). Similarly we can find the change in the total cost of hospitalization attributed to other factors.

A set of logistic regression analyses were carried out to understand the role of age-pattern on hospitalization. The dependent variables used are hospitalization for specific diseases or group of morbidities and the independent variables used are age-group, sex, place of residence (rural-urban), educational attainment and monthly per capita consumption (MPCE) quintile. The model specification is given below:

$$\ln(Y)_{it} = a + b1 * (Age)_{it} + b2 * (Sex)_{it} + b3 * (POR)_{it} + b4 * (Education)_{it} + b5 * (MPCE)_{it} \dots\dots\dots (1)$$

Where Y is the binary variable, that is, whether hospitalized or not for disease i (Yes=1, No=0) at time t , Age is the age-group, POR is the place of residence (rural or urban),

Education is the level of educational attainment of the person and *MPCE* is the monthly per capita consumption expenditure of the household.

Results

The age-pattern of mortality and hospitalization in India has been presented in Figure 1 and 2 respectively. While the age pattern of mortality is borrowed from the cause of death report, India 2001-03, the age pattern of hospitalization for 2014 has been estimated from NSS data. In general, the age pattern of mortality and hospitalization by disease are similar in India. For children below 15 years of age, communicable diseases are the leading cause of death and hospitalization. Injury is the leading cause of death for those in the age group 25-34, while communicable diseases are the leading cause of hospitalization. NCDs are the leading cause of death and hospitalization in India for those who are aged 35+.

[Fig 1 to be embedded here]

[Fig 2 to be embedded here]

Table 1 presents the profile of the households and individuals surveyed in 1995-96 and in 2014. The mean age of population has increased by four years, while the average household size has declined by 0.7 persons over the last two decades. The proportion of children (0-14 years) has declined, while that of elderly population has increased. Educational attainment has improved over time. The monthly per capita consumption expenditure (MPCE), an indicator of household economic well-being, has increased by 37% (at 2014 constant price). However, rural-urban differences in MPCE have remained large over time.

Table 1: Sample profile of individuals and households in India, 1995-2014

Variable	1995	2014
Mean Age (in years)	25.0	28.5
Sex Ratio (Females per 1000 Males)	939	943
Urbanization (%)	24.2	30.0%
Average Household Size	6.23	5.54
Age distribution (%)		
Child Population (0-14)	36.8	29.0
Working Age (15-59)	57.7	63.2
Elderly (60+)	5.5	7.8
Education level		
No Education	48.9	31.5
Primary	29.0	30.3
Secondary	16.4	23.9
Higher Secondary	5.7	14.3
Average Monthly Per Capita Consumption Expenditure (US\$)	20	27
Average Monthly Per Capita Consumption Expenditure (Rural) (US\$)	16	21
Average Monthly Per Capita Consumption Expenditure (Urban) (US\$)	30	40
Number of Households	120942	65932
Number of persons	629888	333104

[Fig 3 to be embedded here]

Fig 3 presents the hospitalization rate in 1995 and 2014 across broad age groups in India. The age pattern of hospitalization rate has shifted upward over time. The overall hospitalization rate (per 100,000 population) has increased more than twice, from 1661 in 1995 to 3699 in 2014. The hospitalization rates of infants (<1 years age) has increased thrice during the period, lowest in the age group 5-9 and lower till age 30. Beyond age 40, the hospitalization rate has increased at a faster rate and by age 80, the hospitalization rate was about five times higher than that of the overall population. Barring infants, the hospitalization rate is an increasing function of age at both time periods.

[Fig 4 to be embedded here]

During 1995-2014, the hospitalization rates for communicable diseases have increased by 47% (from 958 in 1995 to 1412 in 2014) and by 137% for non-communicable diseases (482 to 1142) (Table 2). The age pattern of hospitalization rates of communicable and non-communicable diseases has shown an interesting trend (Fig 4). In 1995, hospitalization due to communicable diseases was higher than the NCDs in eight of the eleven specified age groups (except 50-59, 70-79 and 80+). By 2014, hospitalization due to NCDs was higher in five of the eleven specified age groups (higher for all ages beyond 40). This suggests that NCDs are now advancing and affecting the younger age group. The hospitalization of communicable diseases has shown “U” shaped curve in both the periods and the curve has shifted over time suggesting increasing hospitalization (Fig 4). Hospitalization of communicable diseases has increased among the children and elderly and was highest among infants. Hospitalization beyond age 40 was primarily due to NCDs. Hospitalization due to injuries had also increased across all age groups and showed an increasing pattern (Fig 5). Further, hospitalization due to other diseases had also increased over time especially due to senility among the elderly.

Table 2: Age pattern of hospitalization rate (per 100000 population) by communicable disease, non-communicable diseases, injuries and other diseases in India, 1995-2014

Age	Hospitalization Rate per 100000 Population										Percentage Change (1995-2014)				
	Communicable Disease		Non-Communicable Disease		Injuries		Senility/ Other Diseases		All Diseases		Communicable Disease	Non-Communicable Disease	Injuries	Senility/ Other Diseases	All Disease
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014					
<1	1496	4594	123	372	18	18	107	447	1745	5431	207	201	0	316	211
1-4	1087	2108	150	309	40	132	28	357	1306	2907	94	106	228	1179	123
5-9	410	853	114	202	57	177	30	186	610	1418	108	78	213	515	132
10-19	595	799	175	227	79	344	32	277	881	1646	34	30	335	759	87
20-29	1079	1466	347	486	109	367	47	481	1583	2799	36	40	236	915	77
30-39	1004	1205	469	940	149	391	71	665	1692	3201	20	100	163	832	89
40-49	1093	1254	863	1713	174	602	116	1010	2246	4579	15	98	246	770	104
50-59	1370	1601	1161	2346	198	642	237	1349	2965	5938	17	102	225	469	100
60-69	1706	2214	1726	3961	240	690	549	2351	4221	9217	30	130	188	328	118
70-79	2036	2931	2662	6816	325	739	789	2893	5811	13379	44	156	128	267	130
80+	2744	4299	2235	7829	462	1637	1804	2701	7245	16466	57	250	255	50	127
All Ages	958	1412	482	1141	116	411	106	735	1661	3699	47	137	255	596	123

[Fig 5 to be embedded here]

Table 3 presents the hospitalization rates (per 100,000 population) for fever, diarrhoea and tuberculosis in 1995 and 2014. Hospitalization due to fever has increased for all age groups and does not show any pattern with age in both the periods. The increase in hospitalization was similar for all age groups. In 2014, hospitalization due to fever was highest for the 80+ age group (1169) followed by children in the 1-4 age group (1157). During 1995-2014, hospitalization due to diarrhoea had decreased from 159 to 124. Hospitalization for diarrhoea had declined for all the age-groups except among children under five years. In 2014, hospitalization due to diarrhoea was highest for infants followed by children in the 1-4 age group. Similarly, there was a modest increase in hospitalization due to tuberculosis (from 41 to 50) and this increase was minimal among all hospitalization cases. The age pattern of tuberculosis suggests a decreasing trend across all ages beyond 30, while it has shown an increasing pattern for the age group below 30 years. Table 4 presents the hospitalization rate due to four specific non-communicable diseases, namely, heart diseases, hypertension, diabetes and cancer. Hospitalization due to cancer, heart diseases, hypertension and diabetes has increased more than threefold during the same period. Hospitalization due to these four NCDs is positively associated with age. Hospitalization due to each of these four diseases had increased for each specified age group. The increase is equally high among the working age group (30-69) suggesting that it is significantly affecting the working population. In 1995, the hospitalization rates of cancer (187) and heart diseases (577) was highest in the age group 70-79 and in 2014 it was highest among the 80+ (626 and 3402 respectively). Hospitalization rates for hypertension (954) and diabetes (614) were highest among those in the 70-79 age group.

Table 3: Age pattern of hospitalization rate (per 100000 population) by fever, diarrhoea, tuberculosis and injuries in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population						Percentage Change (1995-2014)		
	Fever		diarrhoea		Tuberculosis		Fever	Diarrhoea	Tuberculosis
	1995	2014	1995	2014	1995	2014			
<1	260	864	213	425	5	0	233	100	-100
1-4	306	1157	364	421	9	40	278	16	351
5-9	124	578	109	79	7	14	366	-28	91
10-19	187	512	91	45	12	24	174	-51	109
20-29	204	544	102	63	33	45	166	-38	33
30-39	196	549	142	97	64	35	181	-31	-46
40-49	190	593	170	82	68	83	212	-52	20
50-59	263	868	221	150	97	89	230	-32	-8
60-69	312	940	206	214	143	89	201	4	-37
70-79	307	928	339	311	121	81	202	-8	-33
80+	338	1169	716	399	108	584	246	-44	443
All Ages	208	659	159	124	41	50	216	-22	24

Table 4: Age pattern of hospitalization rate (per 100000 population) by heart diseases, hypertension, diabetes and cancer in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population								Percentage Change (1995-2014)			
	Heart Disease		Hypertension		Diabetes		Cancer		Heart Diseases	Hypertension	Diabetes	Cancer
	1995	2014	1995	2014	1995	2014	1995	2014				
<30	21	44	3	11	1	7	7	16	110	267	600	129
30-39	39	129	16	43	4	27	27	70	233	166	543	157
40-49	156	402	63	170	30	88	61	142	158	171	198	131
50-59	284	664	133	285	60	193	67	216	134	115	224	224
60-69	331	1280	202	479	119	378	127	407	287	137	216	221
70-79	577	2493	223	954	245	614	187	283	332	328	150	51
80+	309	3402	253	836	34	562	81	626	1002	231	1561	673
All Ages	78	295	32	110	17	73	28	87	276	239	331	216

Cost of Hospitalization in Treating Communicable and Non-Communicable Diseases

Figure 6 shows the mean cost of treatment for communicable diseases, NCDs, injuries and all diseases in 1995 and 2014. Mean cost of hospitalization was US\$ 177 in 1995, which increased to US\$ 316 (by 79 percent) in 2014. Expectedly, NCDs had the highest cost of treatment compared to all other specified categories during both the surveys. The mean cost of treatment of NCDs (US\$ 312 1995 and US\$ 471 in 2014) was about three times higher than that of communicable diseases (US\$ 102 in 1995 and US\$ 175 in 2014) in both the periods. Noticeably, the expenditure on injuries was also very high (US\$ 412 in 2014). During 1995-2014, the mean cost of treatment for communicable diseases had increased by 72 per cent, while that of communicable diseases had increased by 51 per cent at constant prices. Both communicable and NCDs did not show any pattern in cost of treatment with respect to age.

[Fig 6 to be embedded here]

[Fig 7 to be embedded here]

Table 5 presents the mean cost of hospitalization by public and private hospitals for each specified disease at 2014 prices. In 2014, the mean cost of treating cancer was most expensive (US\$ 941) followed by heart disease (US\$ 674) (Fig 7). The pattern holds true for both public and private health centres. The cost of treating diarrhoea was lowest followed by fever. The cost of treatment of each of the diseases in private health centres was about two to three times higher than that in public health centres in both periods. The cost of treatment for all the specified diseases has increased over time. The mean cost of treatment in public

Table 5: Mean cost of treatment in public and private health centers by disease in India, 1995-2014

Diseases	Change in mean cost of hospitalization (in US\$) by public-private expenditure during 1995-2014					
	1995		2014		% Change (1995-2014)	
	Public	Private	Public	Private	Public	Private
Communicable Diseases	66	143	73	250	10.6	74.9
NCDs	196	403	202	607	3.3	50.9
Injuries	165	306	143	615	-13.4	101.1
Fever	44	77	52	186	17.7	142.0
Diarrhoea	32	88	36	155	13.5	76.1
Tuberculosis	133	282	110	398	-17.5	41.1
Heart Diseases	196	823	247	913	25.8	11.0
Hypertension	110	203	68	338	-38.6	66.2
Diabetes	131	254	91	326	-30.1	28.3
Cancer	305	789	466	1257	52.8	59.3
All Diseases	114	244	125	435	9.3	77.9

hospitals has declined for hypertension, diabetes, tuberculosis and injuries. The cost of hospitalization was not only expensive in private health centres but also recorded a faster increase for each of the diseases. The increase in the cost of hospitalization in private health centres had increased the gap between public-private expenditure over time. For example, in 1995, the treatment cost of communicable diseases at private hospitals was twice that in public hospitals (US\$ 66 and US\$ 143 respectively), whereas the difference increased to 3.5 times (US\$ 73 and US\$ 250 respectively) in 2014. Similarly, in 1995-96, the treatment cost of NCDs at private hospitals was twice that in public hospitals (US\$ 196 and US\$ 403 respectively), whereas the difference increased threefold (US\$ 202 and US\$ 607 respectively) in 2014.

Multivariate Analyses

Table 6 presents the odds of hospitalization for communicable diseases, NCDs and injuries and their confidence interval. Hospitalization for a specific category of disease (for instance, communicable diseases) was taken as 1 and 0 for hospitalization of all other diseases. The set

of explanatory variables are age, sex, place of residence, educational attainment and MPCE quintile. Estimates were obtained for 1995 and 2014 and results are presented for 2014 as the patterns were similar over time. Age, sex and place of residence are significant predictors of communicable diseases. With respect to age, the age-group 30-39 is the reference group because the NCDs shows a steady increasing pattern beyond this age-group. Hospitalization for communicable diseases is significantly higher among younger ages compared to the older age groups and the odds of hospitalization decrease with age. For example, the odds of hospitalization among children in the age group 1-4 were six times higher than those in the 30-39 age group. Compared to males, females are significantly more likely to be hospitalized for

Table 6: Results of logistic regression for hospitalization due to communicable, non-communicable diseases and injuries in India, 2014

Covariates	Odds ratio, significance level and confidence interval		
	Communicable Diseases	NCDs	Injuries
Age-Group			
<1	11.04*** (9.08-13.42)	0.17*** (0.13-0.23)	0.16*** (0.11-0.23)
1-4	5.65*** (5.03-6.35)	0.27*** (0.23-0.31)	0.33*** (0.27-0.40)
5-9	3.06*** (2.75-3.48)	0.38*** (0.32-0.44)	0.70*** (0.60-0.83)
10-19	1.85*** (1.70-2.02)	0.44*** (0.39-0.48)	1.05 (0.94-1.17)
20-29	1.79*** (1.66-1.94)	0.55*** (0.50-0.60)	1.02 (0.92-1.13)
30-39®			
40-49	0.69*** (0.63-0.74)	1.45*** (1.34-1.57)	0.92* (0.83-1.02)
50-59	0.59*** (0.55-0.64)	1.71*** (1.60-1.85)	0.76*** (0.68-0.84)
60-69	0.53*** (0.49-0.58)	2.05*** (1.89-2.24)	0.51*** (0.45-0.58)
70-79	0.55*** (0.50-0.62)	2.14*** (1.94-2.36)	0.51*** (0.44-0.59)
80+	0.69*** (0.59-0.80)	2.05*** (1.78-2.35)	0.69*** (0.56-0.85)
Sex			
Male®			
Female	1.41*** (1.35-1.47)	1.03 (0.99-1.09)	0.45*** (0.42-0.48)
Place of Residence			
Rural®			
Urban	0.97 (0.93-1.02)	1.15*** (1.09-1.20)	0.86*** (0.81-0.92)
Education Level			
No Education®			

Primary	1.04(0.97-1.10)	0.99(0.93-1.02)	0.96(0.88-1.05)
Secondary	0.94*(0.88-1.01)	1.01(0.94-1.08)	1.09*(0.99-1.19)
Higher Secondary	0.88*** (0.81-0.95)	0.95(0.88-1.03)	1.20*** (1.08-1.33)
MPCE			
Poorest®			
Poorer	0.95(0.89-1.01)	1.10*** (1.02-1.19)	1.00(0.92-1.10)
Middle	0.94*(0.88-1.01)	1.11*** (1.03-1.19)	1.05(0.96-1.15)
Richer	0.90*** (0.84-0.96)	1.21*** (1.13-1.30)	1.05(0.95-1.15)
Richest	0.79*** (0.73-0.85)	1.41** (1.30-1.52)	1.07(0.97-1.19)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

communicable diseases. Age, sex, place of residence and educational attainment are significant predictors of NCDs. The odds of hospitalization for NCDs are lower than the reference age group for all ages below 30 and higher for all age groups above 40. The odds of hospitalization increase with age, that is, beyond age 40 - 1.45 for the age group 40-49, 1.71 for 50-59 and 2.05 for 60-69 age group. Urban residents are significantly more likely to be hospitalized for NCDs than their rural counterparts. The age pattern of hospitalization of injuries is distinct; it affects those in the age group 30-39 significantly and is lower for all other age groups. The odds of hospitalization decrease with age beyond the reference age group. Females are significantly less likely to be hospitalized for injuries compared to males.

Table 7 presents the odds ratio and confidence interval for three specific diseases, namely- fever, diarrhoea and tuberculosis. The odds of hospitalization for fever and diarrhoea were significantly higher for the younger age group and lower for the older age group. Females are significantly more likely to be hospitalized for fever and diarrhoea. The odds of hospitalization for fever increase with MPCE quintile and decrease for diarrhoea. In the case of tuberculosis, the odds of hospitalization for the older age group is not statistically significant (except 70-79 age group); those in the younger age groups are less likely to be hospitalized compared to those in the 30-39 age group. The odds of hospitalization for

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females and urban residents are significantly lower compared to males and rural residents respectively.

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Table 7: Results of logistic regression for hospitalization of fever, diarrhoea and tuberculosis in India 2014

Covariates	Odds ratio, significance level and confidence interval		
	Fever	Diarrhoea	Tuberculosis
Age-Group			
<1	1.65*** (1.30-2.09)	3.81*** (2.76-5.26)	
1-4	2.44*** (2.13-2.81)	4.62*** (3.71-5.76)	0.23*** (0.13-0.40)
5-9	2.53*** (2.18-2.93)	2.27*** (1.78-2.89)	0.33*** (0.18-0.59)
10-19	2.03*** (1.81-2.28)	1.30** (1.04-1.62)	0.73 (0.51-1.07)
20-29	1.38*** (1.23-1.55)	1.02 (0.81-1.28)	1.29 (0.92-1.79)
30-39®			
40-49	0.69*** (0.62-0.78)	0.77** (0.62-0.97)	1.17 (0.86-1.60)
50-59	0.54*** (0.49-0.61)	0.76** (0.60-0.95)	0.76 (0.54-1.06)
60-69	0.34*** (0.29-0.38)	0.88 (0.69-1.11)	0.86 (0.61-1.21)
70-79	0.27*** (0.23-0.33)	0.70** (0.52-0.94)	0.53*** (0.33-0.85)
80+	0.26*** (0.20-0.33)	0.62** (0.40-0.95)	1.18 (0.72-1.92)
Sex			
Male®			
Female	1.45*** (1.36-1.54)	1.33*** (1.20-1.47)	0.65*** (0.54-0.79)
Place of Residence			
Rural®			
Urban	0.93** (0.87-0.99)	1.13** (1.01-1.25)	0.64*** (0.53-0.78)
Education Level			
No Education®			
Primary	1.08* (0.99-1.18)	0.94 (0.81-1.10)	0.69*** (0.54-0.87)
Secondary	0.94 (0.85-1.03)	0.90 (0.76-1.08)	0.60*** (0.46-0.78)
Higher Secondary	0.87** (0.78-0.98)	0.80 (0.64-1.00)	0.48*** (0.34-0.68)
MPCE			
Poorest®			
Poorer	1.07 (0.97-1.17)	0.96 (0.83-1.11)	0.59*** (0.45-0.76)
Middle	1.16*** (1.06-1.27)	0.81*** (0.70-0.94)	0.58*** (0.45-0.75)
Richer	1.08 (0.98-1.19)	0.66*** (0.56-0.77)	0.65*** (0.50-0.84)
Richest	1.03*** (0.92-1.14)	0.55*** (0.46-0.66)	0.52*** (0.37-0.71)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

The odds of hospitalization for tuberculosis decrease with educational attainment and MPCE quintile. Table 8 presents the odds ratio for hospitalization of heart diseases, hypertension, diabetes and cancer. The odds of being hospitalized were significantly lower among those below 30 years for all the selected diseases. The chances of hospitalization for heart diseases, hypertension and diabetes increased with age, while hospitalization due to cancer was

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significantly lower among those aged 70+ compared to the reference category. Females had lower odds of hospitalization due to heart diseases whilst there were higher chances of their being hospitalized for hypertension, diabetes and cancer. The odds of hospitalization due to diabetes (OR 1.55) and cancer (OR 1.92) were higher among the richest compared to those in the poorest MPCE quintile.

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Table 8: Results of logistic regression for hospitalization of heart diseases, hypertension, diabetes and cancer in India 2014

Covariates	Odds ratio, significance level and confidence interval			
	Heart Diseases	Hypertension	Diabetes	Cancer
Age-Group				
<30	0.43*** (0.36-0.52)	0.24*** (0.16-0.34)	0.27*** (0.18-0.40)	0.31*** (0.24-0.41)
30-39®				
40-49	1.83*** (1.55-2.17)	1.95*** (1.45-2.61)	2.34*** (1.70-3.23)	1.37** (1.08-1.75)
50-59	2.83*** (2.41-3.33)	2.83*** (2.15-3.74)	3.68*** (2.71-5.00)	1.15 (0.89-1.47)
60-69	3.89*** (3.30-4.59)	3.45*** (2.60-4.58)	4.26*** (3.11-5.81)	1.41*** (1.09-1.82)
70-79	4.61*** (3.85-5.51)	3.77*** (2.79-5.11)	3.71*** (2.64-5.22)	0.62*** (0.42-0.88)
80+	4.15*** (3.31-5.19)	3.72*** (2.58-5.37)	2.99*** (1.94-4.61)	0.33*** (0.17-0.63)
Sex				
Male®				
Female	0.83*** (0.76-0.90)	1.24*** (1.08-1.42)	1.47*** (1.27-1.71)	1.81*** (1.56-2.11)
Place of Residence				
Rural®				
Urban	1.30*** (1.19-1.42)	1.54*** (1.33-1.78)	1.28*** (1.10-1.49)	0.87 (0.74-1.03)
Education Level				
No Education®				
Primary	1.05 (0.94-1.17)	1.02 (0.85-1.21)	1.13 (0.94-1.36)	1.08 (0.88-1.31)
Secondary	1.15** (1.02-1.29)	1.01 (0.83-1.22)	1.10 (0.90-1.35)	0.89 (0.72-1.12)
Higher Secondary	1.16** (1.01-1.33)	0.96 (0.75-1.22)	1.00 (0.78-1.30)	1.52*** (1.20-1.93)
MPCE				
Poorest®				
Poorer	1.07 (0.92-1.23)	1.02 (0.90-1.44)	1.52*** (1.17-1.98)	0.92 (0.71-1.21)
Middle	1.08 (0.94-1.24)	1.10 (0.88-1.38)	1.26* (0.97-1.65)	0.98 (0.75-1.26)
Richer	1.22*** (1.07-1.40)	1.05 (0.84-1.32)	1.75*** (1.36-2.25)	1.17 (0.91-1.51)
Richest	1.28*** (1.12-1.48)	0.98 (0.77-1.24)	1.55*** (1.19-2.01)	1.92*** (1.50-2.45)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Decomposition of change in unconditional cost of hospitalization

Mean unconditional cost of hospitalization (per 100,000 population) in India has increased from US\$ 318152 in 1995 to US\$ 1543217 in 2014 (Figure 8). Table 9 presents the results of decomposition analyses on change in unconditional cost of hospitalization attributed to change in age structure of population, rate of hospitalization, number of times hospitalized and per capita real cost of hospitalization. It aims to understand the role of these four factors in increasing cost of hospitalization in India. During 1995-2014, the change in age structure

alone accounted for an increase of 7% in the cost of hospitalization while the rate of hospitalization accounted for 39% and per capita real cost of hospitalization accounted for 14% of the total change in unconditional cost of hospitalization. The combined effect of all these four factors accounted for a 57% increase in total change in cost of hospitalization and 43% increase may be due to interaction effect and other factors.

[Fig 8 to be embedded here]

Table 9: Decomposition of change in unconditional cost of hospitalization due to change in age-structure, rate of hospitalization, mean number of times hospitalized and per capita real cost of hospitalization in India: 1995-2014

Age-group	Change in unconditional cost of hospitalization attributed to				
	Age structure	Hospitalization rate	Mean number of times hospitalized	Per capita real cost of hospitalization	Other factors
<1	1.9	26.9	-0.9	14.6	57.5
1-4	1.2	37.8	-3.6	32.7	31.9
5-9	1.8	37.7	-3.4	31.0	32.8
10-19	8.6	39.7	-6.9	25.4	33.2
20-29	4.5	52.7	-2.0	5.3	39.5
30-39	8.0	33.9	-2.0	13.6	46.5
40-49	14.2	24.4	-3.8	20.8	44.4
50-59	30.2	45.2	-5.3	4.0	26.0
60-69	12.8	18.7	-0.4	16.2	52.6
70-79	10.2	16.2	-0.7	17.1	57.2
80+	9.3	15.2	-0.7	18.1	58.1
All Ages	6.6	39.0	-2.8	13.9	43.2

Discussion

Demographic transition during the last two decades has altered the age structure of India’s population significantly. The size and share of the working population and elderly is growing exponentially. This age-structural transition is not only associated with demographic transition but is also linked to the epidemiological transition, that is, the transition of disease pattern from communicable to non-communicable diseases. The early onset of non-

communicable diseases (NCD) resulting from epidemiological transition is affecting working adults and the elderly equally and has become the leading cause of mortality and morbidity. Further, epidemiological transition not only increases the burden of diseases in a country but also imposes high financial hardship on its government and households. In this context, we examined the age pattern of hospitalization and cost of treatment in India during last the two decades. We have used two rounds of NSS survey data (52nd and 71st round). The 71st round of NSS data is the most recent concluded survey on morbidity and health care in India. The following are the salient findings from our analysis.

First, the age pattern of hospitalisation is similar to that of mortality and NCDs are the leading cause of hospitalization in India. With the exception of the infants, hospitalisation is an increasing function of age and recorded exponential growth beyond age 40. The hospitalization rate has increased more than twice between 1995 and 2014 across all the age-groups and it was more prominent for infants, children and those 60 years and above. This increased hospitalisation may be attributed to an array of factors; - rising morbidity over time, awareness on health benefit of the population, increasing income of the population, availability and accessibility of health services, besides others. Second, hospitalization due to communicable diseases, non-communicable and injuries has increased over time confirming the triple burden of diseases in India[24]. Hospitalization among children was primarily because of communicable disease whereas the NCDs were the leading cause of hospitalization for those aged 40+. Hospitalization due to heart diseases, hypertension, diabetes and cancer had more than tripled during the same period. Third, increasing hospitalization is associated with increasing cost over time irrespective of the diseases. However, the cost of hospitalization was maximum among cancer patients. Fourth, the cost of treatment of NCDs was three times that of communicable diseases. Besides, the cost of treatment in private health care facilities was significantly higher than that in public hospitals.

Other studies have documented that the share of NCDs in out-of-pocket health expenditure incurred by households have increased over time in India[6] and the cost of NCDs are projected to increase in the future[24]. Many studies have shown that the high out-of-pocket health expenditure is catastrophic and the impoverishment impact in general and for poor households in particular pushes many families into the medical poverty trap[12, 17, 19, 34, 35].

During the last decade, there has been a systematic effort by the Government of India to improve health services and protect households from financial catastrophe. In 2008, the Government of India launched the Rashtriya Swasthya Bima Yojana (RSBY), a national health insurance scheme for poor. The main aim of RSBY was to provide health insurance coverage to the families (maximum up to five members) belonging to below poverty line (BPL) and provide access to quality health care and protect them from catastrophic health expenditure. The scheme aimed to enhance the poor people's choice of health care provider by empanelling both public and private hospitals. It provides cashless insurance of up to US\$ 494 per family per year for hospitalization in any of the empanelled hospitals[36]. Studies have documented that the RSBY has been successful in reducing the out-of-pocket expenditure (OOPE) and catastrophic impact on the families[37]. However, the coverage and insurance amount of the RSBY is very low and need to be enhanced. The central government has introduced some other social health insurance schemes such as *Aam Aadmi Bima Yojana* (social security scheme for rural landless households), Universal Health Insurance Scheme (for poor families). The Central Government Health Scheme (CGHS) provides health care facilities for central government employees and pensioners and their dependents [38]. Besides, a number of schemes were launched by some states in India to provide health insurance primarily to poor families. For example, *Rajiv Aarogyasri* Scheme in Andhra Pradesh provides financial protection to the families living below poverty line up to US\$

3292 a year for the treatment of serious ailments requiring hospitalization and surgery. About 938 treatments are covered under this scheme. Likewise, the Gujarat Government has launched *Mukhyamantri Amrutam* scheme which provides quality medical and surgical care to below poverty line families for catastrophic illnesses involving hospitalization, surgeries and therapies through an empanelled network of hospitals. The Chief Minister's Comprehensive Health Insurance Scheme in Tamil Nadu provides free medical and surgical treatment (up to US\$ 2469 per family per year) in government and private hospitals to the members of the family with an annual income less than US\$ 1185[39]. Although studies have documented that health insurance reduces the OOPE and catastrophic health spending, its coverage is still very low; less than 20% of the population is covered under any health insurance scheme in India[40]. Further, many health insurance schemes do not cover chronic illnesses[41] and hence may not reduce the OOPE and catastrophic expenditure in certain households. The recently released National Health Policy, 2017 aimed to increase the central government spending from the current level of 1.15% to 2.5% of the gross domestic product (GDP) by 2025. The policy envisages attaining the highest possible level of health and well-being for all at all ages and providing affordable and universal access to good quality health care services without anyone facing financial catastrophe. It specifically stated its aim to reduce the proportion of household incurring catastrophic health expenditure from the current level by 25%, by 2025[42]. However, the success of the policy depends on how well it is implemented across the country, for this has always been a big hurdle in the Indian context.

Conclusion: During the last two decades, the hospitalization rate in India has increased across all age-groups. The mean cost of hospitalization had grown at least twice over time. Further, the mean cost of hospitalization for NCDs was three times higher than that for communicable diseases in 2014 consequently, imposing high financial burden on the

families. Though the catastrophic and impoverishment effect of out-of-pocket health expenditure was beyond the purview of this study, it has to be mentioned that many poor families are pushed into poverty due to the high treatment cost. The increased public spending on health has a direct effect in reducing the out-of-pocket health expenditure and could be helpful for many households to overcome the medical poverty trap. The Ministry of Health and Family Welfare, Government of India launched the “National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS)” in 2010. Initially, the programme was implemented in 100 districts covering 21 states and there was a proposal to expand it to cover all the districts across the country with special focus on strengthening infrastructure, human resource development, health promotion, early diagnosis, treatment and referral for prevention and control of cancer, diabetes, cardiovascular diseases and stroke[43]. Expansion of the NPCDCS to all of the districts may be helpful in averting many households from the medical poverty trap.

Footnotes

Contributors: AK and SKM have contributed a considerable share of their knowledge and effort. Both the authors (AK and SKM) designed and conceptualized the study. AK analysed the data and drafted the manuscript. SKM finalized the manuscript and gave critical comments for the study.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical Treatment of Experimental Subjects (Animal and Human): This article does not contain any studies with human or animal subjects performed by the author.

Informed Consent: The study used the data set that is available online in public domain; hence, there was no need to seek ethical consent to publish this study.

Funding: This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Data sharing and statement: No additional data are available.

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Figure Legends

Figure 1: Age pattern of death in India by cause of death classification, 2001-03

Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

Figure 3: Age pattern of hospitalization in India, 1995-2014

Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

Figure 6: Mean cost of treatment for communicable diseases, NCDs, injuries and other diseases in India (in US\$), 1995-2014

Figure 7: Mean cost of hospitalization (in US\$) by type of diseases in India, 1995-2014

Figure 8: Mean unconditional cost of hospitalization (in US\$) per 100000 population in India, 1995-2014

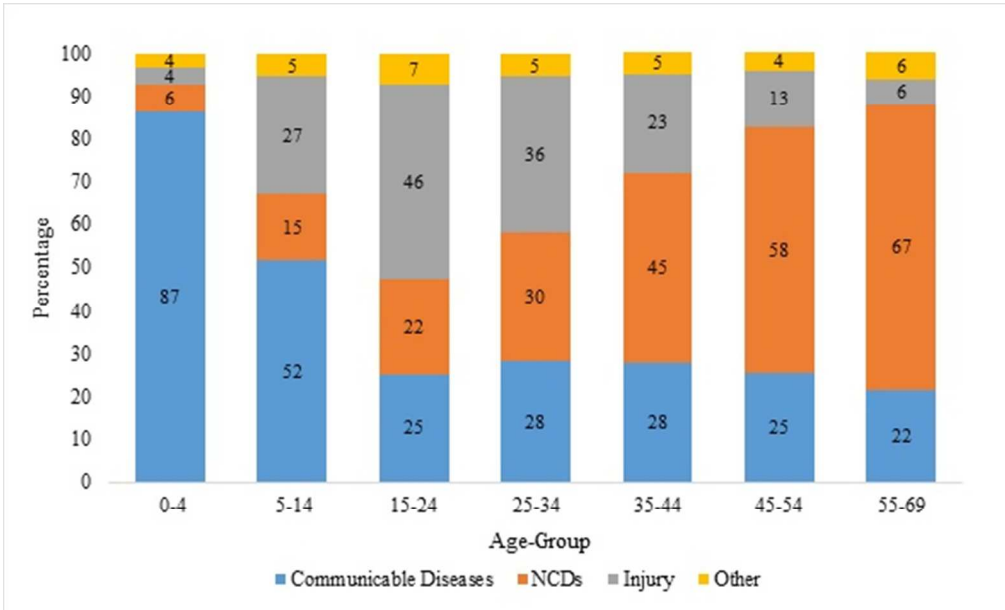


Figure 1: Age pattern of death in India by cause of death classification, 2001-03

49x30mm (300 x 300 DPI)

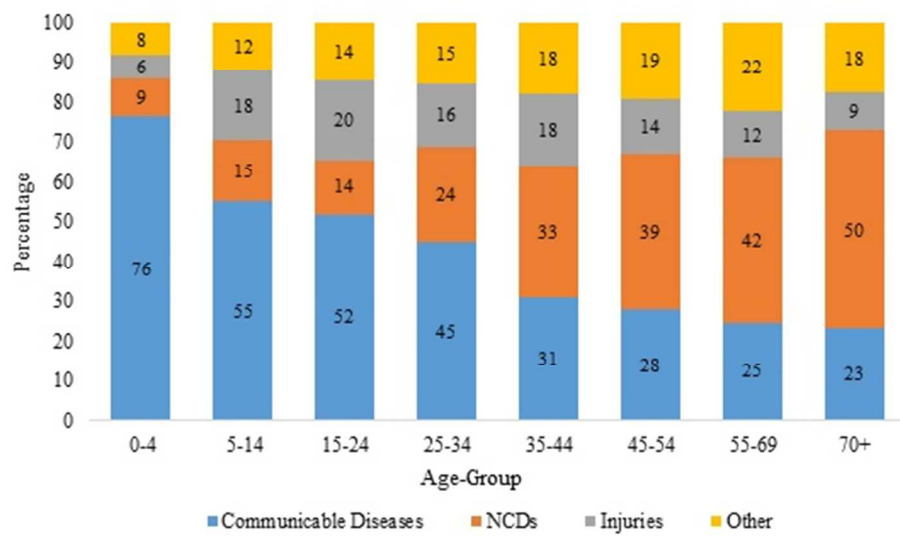


Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

49x29mm (300 x 300 DPI)

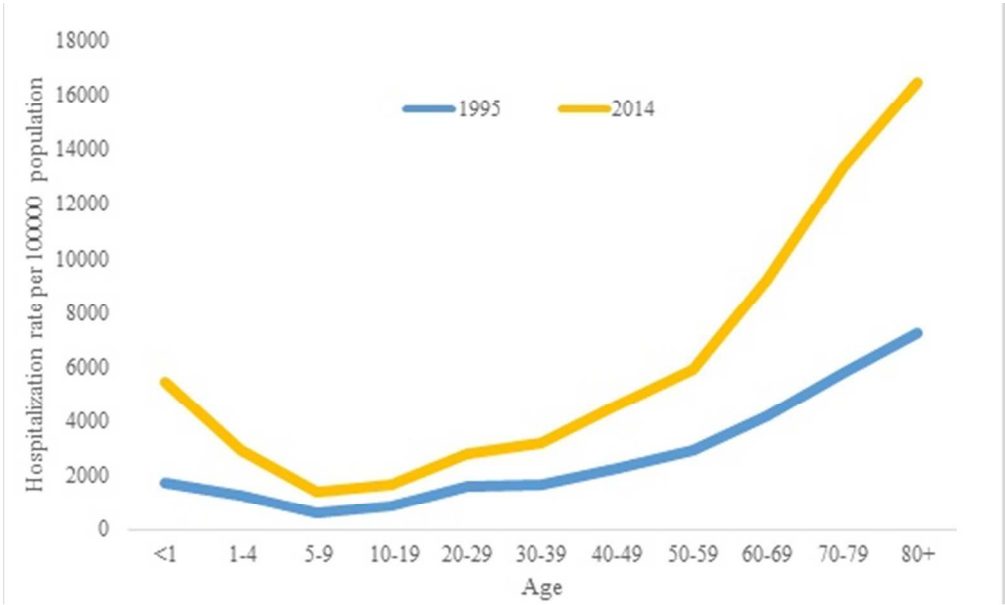


Figure 3: Age pattern of hospitalization in India, 1995-2014

46x28mm (300 x 300 DPI)

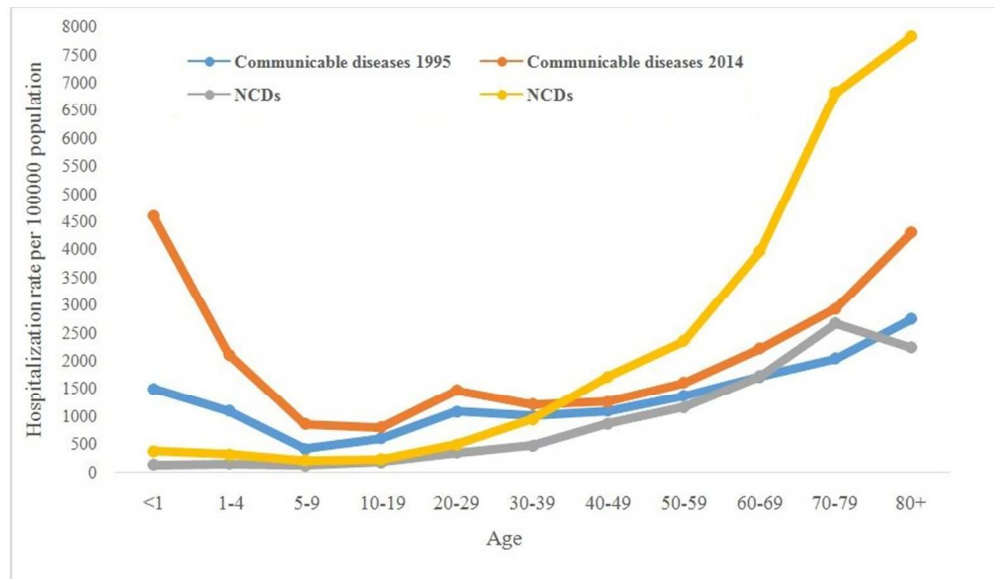


Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

77x44mm (300 x 300 DPI)

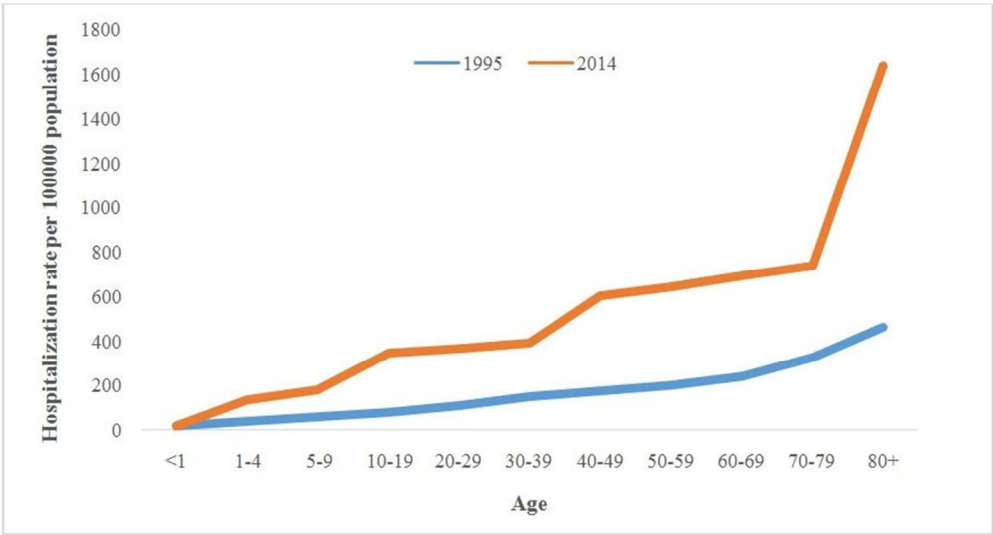


Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

75x41mm (300 x 300 DPI)

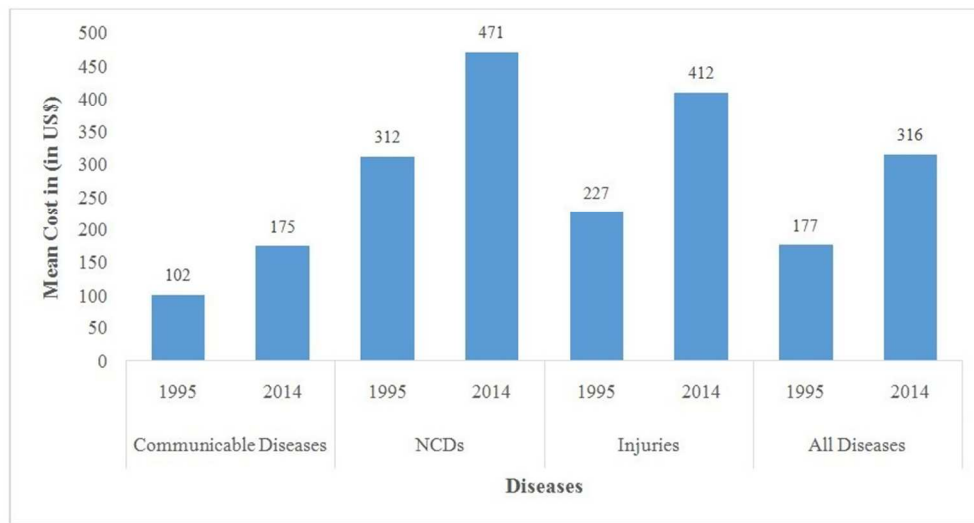


Figure 6: Mean cost of treatment for communicable diseases, NCDs, injuries and other diseases in India (in US\$), 1995-2014

78x41mm (300 x 300 DPI)

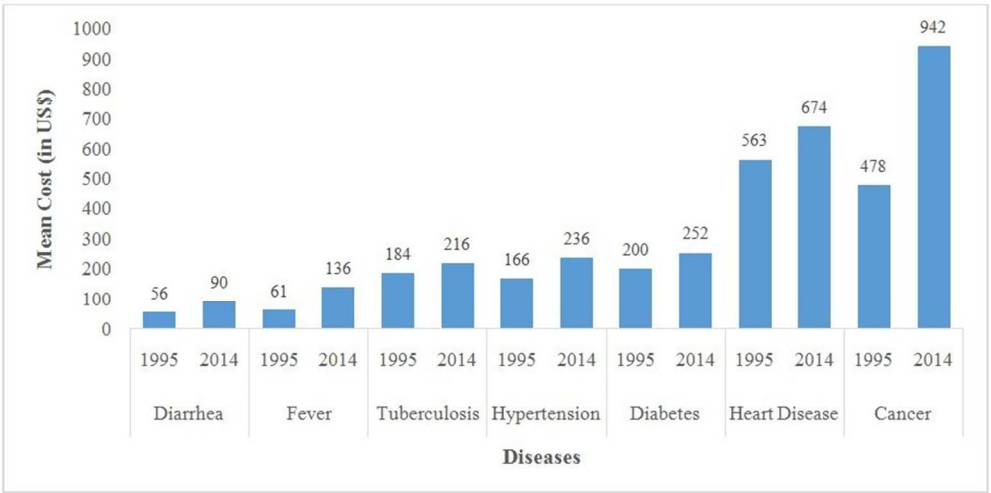


Figure 7: Mean cost of hospitalization (in US\$) by type of diseases in India, 1995-2014

77x39mm (300 x 300 DPI)

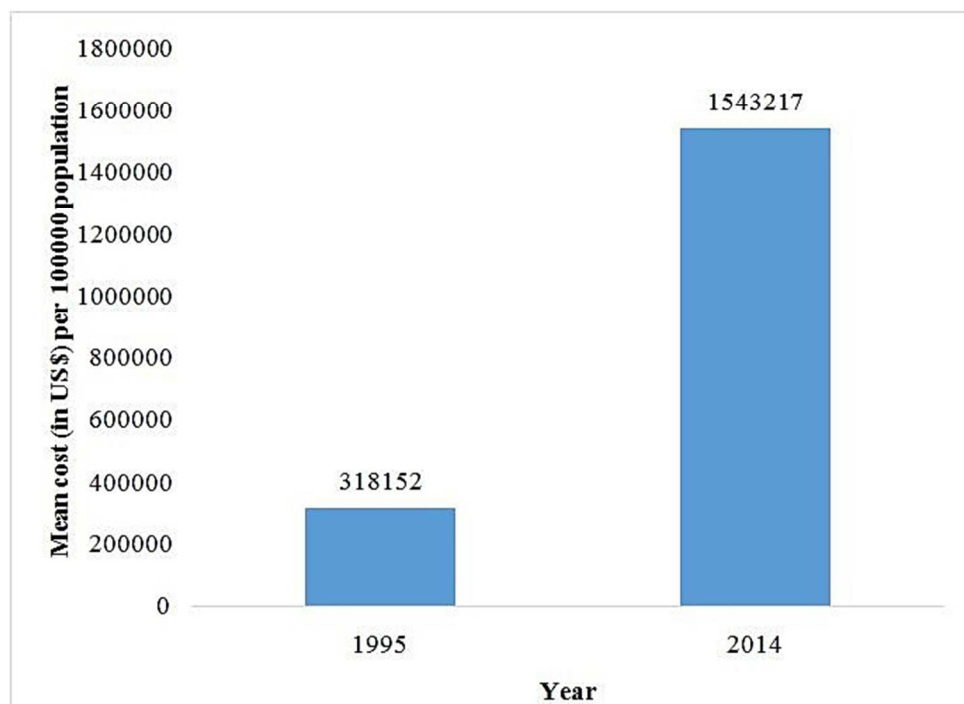


Figure 8: Mean unconditional cost of hospitalization (in US\$) in India, 1995-2014

60x44mm (300 x 300 DPI)

BMJ Open

Disease and Age Pattern of Hospitalization and Associated Costs in India: 1995-2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016990.R2
Article Type:	Research
Date Submitted by the Author:	04-Sep-2017
Complete List of Authors:	Kastor, Anshul; International Institute for Population Sciences, Fertility Studies Mohanty, Sanjay; INTERNATIONAL INSTITUTE FOR POPULATION SCIENCES, DEPARTMENT OF FERTILITY STUDIES
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	Disease and Age-pattern, Non-communicable Diseases, India, Cost of Hospitalization, Hospitalization Rate

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Title:

**Disease and Age Pattern of Hospitalization and Associated Costs in India:
1995-2014**

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Abstract

Objectives: The prime objective of this study is to examine the trends of disease and age pattern of hospitalization and associated costs in India during 1995-2014.

Design: Present study used nationally representative data on morbidity and health care from the 52nd (1995) and 71st (2014) rounds of the National Sample Survey.

Settings: A total of 120,942 and 65,932 households were surveyed in 1995 and 2014 respectively.

Measures: Descriptive statistics, logistic regression analyses and decomposition analyses were used in examining the changes in patterns of hospitalization and associated costs. Hospitalization rates and costs per hospitalization (out-of-pocket expenditure) were estimated for selected diseases and in four broad categories- communicable diseases, NCDs, injuries and others. All the costs are presented at 2014 prices in US dollars.

Results: Hospitalization rate in India has increased from 1661 in 1995 to 3699 in 2014 (per 100000 population). It has more than doubled across all age groups. Hospitalization among children was primarily because of communicable diseases, while NCDs were the leading cause of hospitalization for the 40+ population. Costs per hospitalization have increased from US\$ 177 in 1995 to US\$ 316 in 2014 (an increase of 79%). Costs per hospitalization for NCDs in 2014 were US\$ 471 compared to US\$ 175 for communicable diseases. It was highest for cancer inpatients (US\$ 942) followed by heart diseases (US\$ 674). Age is the significant predictor of hospitalization for all the selected diseases. Decomposition results showed that about half of the increase in unconditional costs per hospitalization was due to

increase in hospitalization rates, and the other half was due to increase in mean hospital costs.

Conclusion: There has been more than two fold increase in hospitalization rates in India during the last two decades and significantly higher rates were observed among infants and older adults. Hospitalization rates and increase in costs per hospitalization are contributing equally to the rising health care costs in India.

Strengths and limitations of this study

- This study provides disease specific hospitalization rates in a more comprehensive manner than ever using 11 age-groups.
- Change in disease specific costs per hospitalization has been estimated over past two decades.
- It decomposes the increase in unconditional costs per hospitalization by increase in mean hospitals costs and hospitalization rates.
- Study only uses the hospitalization cost which underestimates the total financial burden incurred by households on health care.

Introduction

Demographic transition and epidemiological transition have altered the age pattern of mortality and morbidity globally and nationally. While there has been significant progress in the reduction of infant and child mortality, adult mortality has shown varying patterns across regions and countries with deaths occurring at progressively older ages[1-2]. Non-communicable diseases (NCDs) are now the leading cause of mortality, hospitalization and

1
2
3 disability in both developed and developing countries[3-4]. Social, economic and human loss
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5 due to the changing disease-pattern is profound and is affecting economic growth and
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7 development adversely across countries[5-6].
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11 The human capital models are based on the premise that health depreciates with age and can
12
13 be augmented by investing in health, including medical care[7]. Medical care is positively
14
15 associated with income, educational attainment, accessibility and availability of health
16
17 services and the share of elderly population[8-11]. Age structural transition (due to
18
19 demographic shift), increasing medical care, technological advancement and increase in the
20
21 real cost of treatment are driving medical costs exponentially. Medical spending in
22
23 developing countries is catastrophic for large households and families[12-20]. Though,
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25 publically funded health programs are covering primary health services, they are not
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27 equipped to meet the challenge of growing non-communicable diseases.
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33 Demographic change in India is marked by three key developments - falling fertility in the
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35 states, increase in longevity across age and improvement in child survival across
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37 socioeconomic groups. While the country is nearing to the replacement level of fertility,
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39 increase in longevity has been experienced across all age groups. Life expectancy at birth has
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41 increased from 59.4 years in 1991 to 66.1 years in 2011[21]. Under-five mortality has
42
43 reduced by more than half during the same period and is now estimated at 55 per 1000 live
44
45 births[22]. These positive developments are accompanied with a changing disease pattern
46
47 (increase share of non-communicable diseases and injuries). NCDs have become the leading
48
49 cause of mortality, disability and morbidity in India[23] and are projected to increase in the
50
51 coming years[24].
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Evidence suggests that household health spending in India accounts for 71 per cent of total health spending[25] and is catastrophic to a large number of households. Hospitalization accounts for a large share of medical spending and the pattern of hospitalization vary across different ages. Besides, the growth rate of household health spending is faster than the growth rate of household economic well-being[26]. Though some attempt has been made to address the morbidity and disease pattern in India, there has been no study on the age pattern of hospitalization and associated costs in India. This paper aims to examine the trends in the age pattern of hospitalization and associated costs by selected diseases in India.

Methods

Data

The unit data from Schedule 25.0 of the 52nd (1995-96) and 71st rounds (2014) of the National Sample Survey (NSS) conducted by the National Sample Survey Organization (NSSO), Government of India are used in the analyses. These rounds of surveys are the only data bases that provide comprehensive and comparable information on the morbidity pattern and health care utilization covering the entire population in India. A total of 120,942 households and 633,408 individuals (629,888 alive and 3,520 death cases) were covered in 1995, and 65,932 households and 335,499 individuals (333,104 alive and 2,395 death cases) in 2014. The survey covered all states and union territories and the households were selected using multi-stage stratified sampling procedure. Details of the sampling designs and the survey findings are available in the reports of the respective rounds[27-28]. Schedule 25.0 of these two rounds has detailed information on types of ailment, duration of ailment, health care utilization, hospitalization, source of treatment (public/private) and expenditure incurred by each member of the sampled households on treatment of diseases/hospitalization. Data on medical expenditure on medicines, surgery, diagnostic tests, doctor’s fees and lodging

charges (direct expenditure) and expenditure on transport charges, and other charges indirect/non-medical expenses are available in both rounds of the survey. Our estimates on the costs of hospitalization include all direct and indirect expenditures incurred by household members on hospitalization.

Data on hospitalization (defined as an overnight stay in the hospital anytime) were collected in a reference period of 365 days and for out-patients (visit to a health care professional/health center and not an overnight stay) in a reference period of fifteen days. We have used only those cases that were hospitalized because they have the advantage of having been medically diagnosed and provided treatment. The number of hospitalized cases were 26,526 in 1995 and 42,869 in 2014. To compare the cost of hospitalization over time, expenditure is first adjusted to uniform base year (1987-88) and then adjusted at constant prices (2014 prices)[29]. All the estimates are presented in US Dollars (average exchange rate US\$ 1=INR 60.745) and at 2014 prices. Costs that we referred to in the analysis is out-of-pocket expenditure that was incurred during hospitalization.

Analytical Approach

For analytical purposes, we have classified the diseases into four broad categories, namely, communicable diseases, non-communicable diseases, injuries and other diseases similar to the classification of Cause of Death, India 2001-03[25]. Communicable diseases include all types of fever, filariasis, tetanus, diarrhoea, jaundice, respiratory diseases, anaemia, tuberculosis, HIV/AIDS and other sexually transmitted diseases, while non-communicable diseases include cancer, diabetes, heart diseases, hypertension, asthma, musculoskeletal, genito-urinary, psychiatric and neurological illnesses. Disease specific analyses have been carried out by considering the frequencies and importance of the diseases. The specific

diseases covered are fever, diarrhoea, tuberculosis, cancer, heart diseases, hypertension, diabetes and injuries. A total of eleven broad age-groups, namely, <1, 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+ are used in the analysis. Analyses have been limited to the national level.

Hospitalization rate, descriptive statistics, decomposition method and logistic regressions are used in the analyses. Hospitalization rate is defined as the number of spells of hospitalization anytime during the one year preceding the survey of the population exposed to risk[30].

$$\text{Hospitalization Rate} = \frac{\text{Total Number of Spells of Hospitalization during last 365 days}}{\text{Population Exposed to Risk}} * 100000$$

Hospitalization rate is expressed per 100,000 population. Costs per hospitalization by diseases and age groups are presented over time. Bivariate analyses were carried out to understand the differentials and variations in hospitalization and associated cost over time.

We have used the decomposition method to understand the role of mean hospital costs and hospitalization rates in affecting the change in unconditional costs per hospitalization over time. A detailed description and review of the decomposition method and its underlying assumption can be found elsewhere [31-33].The advantage of using this method is that we can attribute the changes in unconditional costs per hospitalization to the change in hospitalization rates and change in mean hospital costs. The decomposition model is given as;

$$\text{Unconditional costs [t+1]} - \text{Unconditional costs [t]} = (\text{Mean hospital costs[t+1]} - \text{Mean hospital costs[t]} * \text{Hospitalization rates [t+1]}) + (\text{Hospitalization rates[t+1]} - \text{Hospitalization rates[t]} * \text{Mean hospital costs [t]})$$

Where, [t] is “Year 1995”

[t+1] is “Year 2014”

The first term in the above decomposition method is the changes in costs due to hospital costs and the second term is change in costs due to hospitalization rates. All the indicators used in this decomposition method are unweighted cases. Thus, results presented for the decomposition method are based on unweighted cases.

A set of logistic regression analyses was carried out to understand the role of age-pattern on hospitalization. The dependent variables used are hospitalization for specific diseases or group of morbidities and the independent variables used are age-group, sex, place of residence (rural-urban), educational attainment and monthly per capita consumption (MPCE) quintile. The model specification is given below:

$$\ln(Y)_{it} = a + b1*(Age)_{it} + b2*(Sex)_{it} + b3*(POR)_{it} + b4*(Education)_{it} + b5*(MPCE)_{it} \dots\dots\dots(1)$$

Where Y is the binary variable, that is, whether hospitalized or not for disease i (Yes=1, No=0) at time t , Age is the age-group, POR is the place of residence (rural or urban), $Education$ is the level of educational attainment of the person and $MPCE$ is the monthly per capita consumption expenditure of the household.

Results

Age-pattern of mortality and hospitalization in India has been presented in Figure 1 and 2 respectively. While the age pattern of mortality is taken from the Cause of Death Report, India 2001-03, the age pattern of hospitalization for 2014 has been estimated from NSS data. In general, the age pattern of mortality and hospitalization by disease are similar in India. For children below 15 years of age, communicable diseases are the leading cause of death

and hospitalization. Injury is the leading cause of death for those in the age group 25-34, while communicable diseases are the leading cause of hospitalization. NCDs are the leading cause of death and hospitalization in India for those who are aged 35+.

[Fig 1 to be embedded here]

[Fig 2 to be embedded here]

Table 1 presents the profile of the households and individuals surveyed in 1995-96 and in 2014. Mean age of the population has increased by four years, while the average household size has declined by 0.7 persons over the last two decades. The proportion of children (0-14 years) has declined, while that of the elderly population has increased. Educational attainment has improved over time. Monthly per capita consumption expenditure (MPCE), an indicator of household economic well-being, has increased by 37% (at 2014 constant price). However, rural-urban differences in MPCE have remained large over time.

Table 1: Sample profile of individuals and households in India, 1995-2014

Variable	1995	2014
Mean Age (in years)	25.0	28.5
Sex Ratio (Females per 1000 Males)	939	943
Urbanization (%)	24.2	30.0%
Average Household Size	6.23	5.54
Age Distribution (%)		
Child Population (0-14)	36.8	29.0
Working Age (15-59)	57.7	63.2
Elderly (60+)	5.5	7.8
Education Level		
No Education	48.9	31.5

Primary	29.0	30.3
Secondary	16.4	23.9
Higher Secondary	5.7	14.3
Average Monthly Per Capita Consumption Expenditure (US\$)	20	27
Average Monthly Per Capita Consumption Expenditure (Rural) (US\$)	16	21
Average Monthly Per Capita Consumption Expenditure (Urban) (US\$)	30	40
Number of Households	120942	65932
Number of persons	629888	333104

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[Fig 3 to be embedded here]

Fig 3 presents the hospitalization rates in 1995 and 2014 across broad age groups in India. Age pattern of hospitalization rate has shifted upward over time. The overall hospitalization rate (per 100,000 population) has increased more than twice, from 1661 in 1995 to 3699 in 2014. Hospitalization rates of infants (<1 years age) have increased thrice during the period, lowest in the age group 5-9 and lower till age 30. Beyond age 40, hospitalization rates increased at a faster rate and by age 80, the rates were about five times higher than that of the overall population.

[Fig 4 to be embedded here]

During 1995-2014, the hospitalization rates for communicable diseases have increased by 47% (from 958 in 1995 to 1412 in 2014) and by 137% for non-communicable diseases (482 to 1142) (Table 2). The age-patterns of hospitalization rates due to communicable and non-communicable diseases have shown interesting trends (Fig 4). In 1995, hospitalization due to communicable diseases was higher than the NCDs in eight of the eleven specified age groups (except 50-59, 70-79 and 80+). By 2014, hospitalization due to NCDs was higher in five of the eleven specified age groups (higher for all ages beyond 40). This suggests that NCDs are now advancing and affecting the younger age group. Hospitalization due to communicable diseases has shown a “U” shaped curve in both the periods and the curve has shifted over time suggesting increasing hospitalization (Fig 4). It had increased among the children and elderly and was highest among infants. Hospitalization beyond age 40 was primarily due to NCDs. Hospitalization due to injuries had also increased across all age groups and showed an increasing pattern (Fig 5). Further, hospitalization due to other diseases had also increased over time especially due to senility among the elderly.

Table 2: Age pattern of hospitalization rate (per 100000 population) by communicable disease, non-communicable diseases, injuries and other diseases in India, 1995-2014

Age	Hospitalization Rate per 100000 Population										Percentage Change (1995-2014)				
	Communicable Disease		Non-Communicable Disease		Injuries		Senility/ Other Diseases		All Diseases		Communicable Disease	Non-Communicable Disease	Injuries	Senility/ Other Diseases	All Disease
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014					
<1	1496	4594	123	372	18	18	107	447	1745	5431	207	201	0	316	211
1-4	1087	2108	150	309	40	132	28	357	1306	2907	94	106	228	1179	123
5-9	410	853	114	202	57	177	30	186	610	1418	108	78	213	515	132
10-19	595	799	175	227	79	344	32	277	881	1646	34	30	335	759	87
20-29	1079	1466	347	486	109	367	47	481	1583	2799	36	40	236	915	77
30-39	1004	1205	469	940	149	391	71	665	1692	3201	20	100	163	832	89
40-49	1093	1254	863	1713	174	602	116	1010	2246	4579	15	98	246	770	104
50-59	1370	1601	1161	2346	198	642	237	1349	2965	5938	17	102	225	469	100
60-69	1706	2214	1726	3961	240	690	549	2351	4221	9217	30	130	188	328	118
70-79	2036	2931	2662	6816	325	739	789	2893	5811	13379	44	156	128	267	130
80+	2744	4299	2235	7829	462	1637	1804	2701	7245	16466	57	250	255	50	127
All Ages	958	1412	482	1141	116	411	106	735	1661	3699	47	137	255	596	123

[Fig 5 to be embedded here]

Table 3 presents the hospitalization rates (per 100,000 population) for fever, diarrhoea and tuberculosis in 1995 and 2014. Hospitalization due to fever had increased for all age groups and showed no pattern with age in either time points. The increase in hospitalization was similar for all age groups. In 2014, hospitalization due to fever was highest for the 80+ age group (1169) followed by children in the 1-4 age group (1157). During 1995-2014, hospitalization due to diarrhoea had decreased from 159 to 124. Hospitalization for diarrhoea had declined for all the age-groups except among children under five years. In 2014, hospitalization due to diarrhoea was highest for infants followed by children in the 1-4 age group. Similarly, there was a modest increase in hospitalization due to tuberculosis (from 41 to 50) and this increase was minimal among all hospitalization cases. Age-pattern of tuberculosis suggests a decreasing trend across all ages beyond 30, while it showed an increasing pattern for the age group below 30 years. Table 4 presents the hospitalization rate due to four specific non-communicable diseases, namely, heart diseases, hypertension, diabetes and cancer. Hospitalization due to cancer, heart diseases, hypertension and diabetes had increased more than threefold during the same period. Hospitalization due to these four NCDs is positively associated with age. Hospitalization due to each of these four diseases had increased for each specified age group. The increase was equally high among the working age group (30-69) suggesting that it was significantly affecting the working population. In 1995, the hospitalization rates of cancer (187) and heart diseases (577) was highest in the age group 70-79 and in 2014 it was highest among the 80+ (626 and 3402 respectively). Hospitalization rates for hypertension (954) and diabetes (614) were highest among those in the 70-79 age group.

Table 3: Age pattern of hospitalization rate (per 100000 population) by fever, diarrhoea, tuberculosis and injuries in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population						Percentage Change (1995-2014)		
	Fever		diarrhoea		Tuberculosis		Fever	Diarrhoea	Tuberculosis
	1995	2014	1995	2014	1995	2014			
<1	260	864	213	425	5	0	233	100	-100
1-4	306	1157	364	421	9	40	278	16	351
5-9	124	578	109	79	7	14	366	-28	91
10-19	187	512	91	45	12	24	174	-51	109
20-29	204	544	102	63	33	45	166	-38	33
30-39	196	549	142	97	64	35	181	-31	-46
40-49	190	593	170	82	68	83	212	-52	20
50-59	263	868	221	150	97	89	230	-32	-8
60-69	312	940	206	214	143	89	201	4	-37
70-79	307	928	339	311	121	81	202	-8	-33
80+	338	1169	716	399	108	584	246	-44	443
All Ages	208	659	159	124	41	50	216	-22	24

Table 4: Age pattern of hospitalization rate (per 100000 population) by heart diseases, hypertension, diabetes and cancer in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population								Percentage Change (1995-2014)			
	Heart Disease		Hypertension		Diabetes		Cancer		Heart Diseases	Hypertension	Diabetes	Cancer
	1995	2014	1995	2014	1995	2014	1995	2014				
<30	21	44	3	11	1	7	7	16	110	267	600	129
30-39	39	129	16	43	4	27	27	70	233	166	543	157
40-49	156	402	63	170	30	88	61	142	158	171	198	131
50-59	284	664	133	285	60	193	67	216	134	115	224	224
60-69	331	1280	202	479	119	378	127	407	287	137	216	221
70-79	577	2493	223	954	245	614	187	283	332	328	150	51
80+	309	3402	253	836	34	562	81	626	1002	231	1561	673
All Ages	78	295	32	110	17	73	28	87	276	239	331	216

Costs Per Hospitalization for Communicable and Non-Communicable Diseases

Figure 6 shows the costs per hospitalization for communicable diseases, NCDs, injuries and all diseases in 1995 and 2014. Costs per hospitalization were US\$ 177 in 1995, which increased to US\$ 316 (by 79 percent) in 2014. Expectedly, NCDs had the highest costs per hospitalization compared to all other specified categories during both the surveys. For example, costs per hospitalization for NCDs (US\$ 312 in 1995 and US\$ 471 in 2014) was about three times higher than that of communicable diseases (US\$ 102 in 1995 and US\$ 175 in 2014) in both the points. Noticeably, expenditure on injuries was also very high (US\$ 412 in 2014). During 1995-2014, costs per hospitalization for communicable diseases had increased by 72 per cent, while that of communicable diseases had increased by 51 per cent at constant prices. Both communicable and NCDs did not show any pattern in the cost of hospitalization with respect to age.

[Fig 6 to be embedded here]

[Fig 7 to be embedded here]

Table 5 presents costs per hospitalization by public and private hospitals for each specified disease at 2014 prices. In 2014, costs per hospitalization for cancer was most expensive (US\$ 941) followed by heart disease (US\$ 674) (Fig 7). This pattern holds true for both public and private health centres. It was lowest for diarrhoea followed by fever. Notably, costs per hospitalization for each of the diseases in private health centres was about two to three times higher than that in public health centres in both periods. Costs per hospitalization for all the specified diseases had increased over time. Further, costs per hospitalization in public

Table 5: Costs per hospitalization in public and private health centers by disease in India, 1995-2014

Diseases	Change in mean cost of hospitalization (in US\$) by public-private expenditure during 1995-2014					
	1995		2014		% Change (1995-2014)	
	Public	Private	Public	Private	Public	Private
Communicable Diseases	66	143	73	250	10.6	74.9
NCDs	196	403	202	607	3.3	50.9
Injuries	165	306	143	615	-13.4	101.1
Fever	44	77	52	186	17.7	142.0
Diarrhoea	32	88	36	155	13.5	76.1
Tuberculosis	133	282	110	398	-17.5	41.1
Heart Diseases	196	823	247	913	25.8	11.0
Hypertension	110	203	68	338	-38.6	66.2
Diabetes	131	254	91	326	-30.1	28.3
Cancer	305	789	466	1257	52.8	59.3
All Diseases	114	244	125	435	9.3	77.9

hospitals have declined for hypertension, diabetes, tuberculosis and injuries. Hospitalization costs were not only expensive in private health centres but also recorded a faster increase for each of the diseases. Increase in the costs per hospitalization in private health centres had increased the gap between public-private expenditure over time. For example, in 1995, costs per hospitalization for communicable diseases in private hospitals was twice higher than that in public hospitals (US\$ 66 and US\$ 143 respectively), whereas the difference increased to 3.5 times (US\$ 73 and US\$ 250 respectively) in 2014. Similarly, in 1995-96, per capita cost of hospitalization for NCDs in private hospitals was twice higher than that in public hospitals (US\$ 196 and US\$ 403 respectively), whereas the difference increased by threefold (US\$ 202 and US\$ 607 respectively) in 2014.

Multivariate Analyses

Table 6 presents the odds of hospitalization for communicable diseases, NCDs and injuries and their confidence interval. Hospitalization for a specific category of disease (for instance, communicable diseases) was taken as 1 and 0 for hospitalization of all other diseases. The set

of explanatory variables are age, sex, place of residence, educational attainment and MPCE quintile. Estimates were obtained for 1995 and 2014 and results were presented for 2014 as the patterns were similar over time. Age, sex and place of residence are significant predictors of communicable diseases. With respect to age, the age-group 30-39 is the reference group because NCDs showed a steady increasing pattern beyond this age-group. Hospitalization for communicable diseases was significantly higher among younger ages compared to older age groups and the odds of hospitalization decrease with age. For example, the odds of hospitalization among children in the age group 1-4 were six times higher than those in the 30-39 age group. Compared to males, females were significantly more likely to be hospitalized for

Table 6: Results of logistic regression for hospitalization due to communicable, non-communicable diseases and injuries in India, 2014

Covariates	Odds ratio, significance level and confidence interval		
	Communicable Diseases	NCDs	Injuries
Age-Group			
<1	11.04*** (9.08-13.42)	0.17*** (0.13-0.23)	0.16*** (0.11-0.23)
1-4	5.65*** (5.03-6.35)	0.27*** (0.23-0.31)	0.33*** (0.27-0.40)
5-9	3.06*** (2.75-3.48)	0.38*** (0.32-0.44)	0.70*** (0.60-0.83)
10-19	1.85*** (1.70-2.02)	0.44*** (0.39-0.48)	1.05 (0.94-1.17)
20-29	1.79*** (1.66-1.94)	0.55*** (0.50-0.60)	1.02 (0.92-1.13)
30-39®			
40-49	0.69*** (0.63-0.74)	1.45*** (1.34-1.57)	0.92* (0.83-1.02)
50-59	0.59*** (0.55-0.64)	1.71*** (1.60-1.85)	0.76*** (0.68-0.84)
60-69	0.53*** (0.49-0.58)	2.05*** (1.89-2.24)	0.51*** (0.45-0.58)
70-79	0.55*** (0.50-0.62)	2.14*** (1.94-2.36)	0.51*** (0.44-0.59)
80+	0.69*** (0.59-0.80)	2.05*** (1.78-2.35)	0.69*** (0.56-0.85)
Sex			
Male®			
Female	1.41*** (1.35-1.47)	1.03 (0.99-1.09)	0.45*** (0.42-0.48)
Place of Residence			
Rural®			
Urban	0.97 (0.93-1.02)	1.15*** (1.09-1.20)	0.86*** (0.81-0.92)
Education Level			
No Education®			

Primary	1.04(0.97-1.10)	0.99(0.93-1.02)	0.96(0.88-1.05)
Secondary	0.94*(0.88-1.01)	1.01(0.94-1.08)	1.09*(0.99-1.19)
Higher Secondary	0.88*** (0.81-0.95)	0.95(0.88-1.03)	1.20*** (1.08-1.33)
MPCE			
Poorest®			
Poorer	0.95(0.89-1.01)	1.10*** (1.02-1.19)	1.00(0.92-1.10)
Middle	0.94*(0.88-1.01)	1.11*** (1.03-1.19)	1.05(0.96-1.15)
Richer	0.90*** (0.84-0.96)	1.21*** (1.13-1.30)	1.05(0.95-1.15)
Richest	0.79*** (0.73-0.85)	1.41** (1.30-1.52)	1.07(0.97-1.19)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

communicable diseases. Age, sex, place of residence and educational attainment were significant predictors of NCDs. The odds of hospitalization for NCDs were for all ages below 30 and higher for all age groups above 40 than that for the reference age group. Likelihood of hospitalization increased with age, that is, beyond age 40 - 1.45 for the age group 40-49, 1.71 for 50-59 and 2.05 for 60-69. Urban residents were significantly more likely to be hospitalized for NCDs than their rural counterparts. Age-pattern of hospitalization of injuries was distinct; it affected those in the age group 30-39 significantly and was lower for all other age groups. The odds of hospitalization decreased with age beyond the reference age group. Females were significantly less likely to be hospitalized for injuries compared to males.

Table 7 presents the odds ratio and confidence interval for three specific diseases, namely- fever, diarrhoea and tuberculosis. Odds of hospitalization for fever and diarrhoea were significantly higher for the younger age group and lower for the older age group. Females were significantly more likely to be hospitalized for fever and diarrhoea. Chances of hospitalization for fever increased with MPCE quintile and decreased for diarrhoea. In the case of tuberculosis, the odds of hospitalization for the older age group were not statistically significant (except 70-79 age group); those in the younger age groups were lesser likely to be hospitalized compared to those in the 30-39 age group. Likelihood of hospitalization for

females and urban residents were significantly lower compared to males and rural residents respectively.

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Table 7: Results of logistic regression for hospitalization of fever, diarrhoea and tuberculosis in India 2014

Covariates	Odds ratio, significance level and confidence interval		
	Fever	Diarrhoea	Tuberculosis
Age-Group			
<1	1.65*** (1.30-2.09)	3.81*** (2.76-5.26)	
1-4	2.44*** (2.13-2.81)	4.62*** (3.71-5.76)	0.23*** (0.13-0.40)
5-9	2.53*** (2.18-2.93)	2.27*** (1.78-2.89)	0.33*** (0.18-0.59)
10-19	2.03*** (1.81-2.28)	1.30** (1.04-1.62)	0.73 (0.51-1.07)
20-29	1.38*** (1.23-1.55)	1.02 (0.81-1.28)	1.29 (0.92-1.79)
30-39®			
40-49	0.69*** (0.62-0.78)	0.77** (0.62-0.97)	1.17 (0.86-1.60)
50-59	0.54*** (0.49-0.61)	0.76** (0.60-0.95)	0.76 (0.54-1.06)
60-69	0.34*** (0.29-0.38)	0.88 (0.69-1.11)	0.86 (0.61-1.21)
70-79	0.27*** (0.23-0.33)	0.70** (0.52-0.94)	0.53*** (0.33-0.85)
80+	0.26*** (0.20-0.33)	0.62** (0.40-0.95)	1.18 (0.72-1.92)
Sex			
Male®			
Female	1.45*** (1.36-1.54)	1.33*** (1.20-1.47)	0.65*** (0.54-0.79)
Place of Residence			
Rural®			
Urban	0.93** (0.87-0.99)	1.13** (1.01-1.25)	0.64*** (0.53-0.78)
Education Level			
No Education®			
Primary	1.08* (0.99-1.18)	0.94 (0.81-1.10)	0.69*** (0.54-0.87)
Secondary	0.94 (0.85-1.03)	0.90 (0.76-1.08)	0.60*** (0.46-0.78)
Higher Secondary	0.87** (0.78-0.98)	0.80 (0.64-1.00)	0.48*** (0.34-0.68)
MPCE			
Poorest®			
Poorer	1.07 (0.97-1.17)	0.96 (0.83-1.11)	0.59*** (0.45-0.76)
Middle	1.16*** (1.06-1.27)	0.81*** (0.70-0.94)	0.58*** (0.45-0.75)
Richer	1.08 (0.98-1.19)	0.66*** (0.56-0.77)	0.65*** (0.50-0.84)
Richest	1.03*** (0.92-1.14)	0.55*** (0.46-0.66)	0.52*** (0.37-0.71)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Odds of hospitalization for tuberculosis decrease with educational attainment and MPCE quintile. Table 8 presents the odds ratio for hospitalization of heart diseases, hypertension, diabetes and cancer. Likelihood of being hospitalized was significantly lower among those below 30 years for all the selected diseases. The chances of hospitalization for heart diseases, hypertension and diabetes increased with age, while hospitalization due to cancer was

significantly lower among those aged 70+ compared to the reference category. Females had lower odds of hospitalization due to heart diseases whilst there were higher chances of them being hospitalized for hypertension, diabetes and cancer. Odds of hospitalization due to diabetes (OR 1.55) and cancer (OR 1.92) were higher among the richest compared to those in the poorest MPCE quintile.

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Table 8: Results of logistic regression for hospitalization of heart diseases, hypertension, diabetes and cancer in India 2014

Covariates	Odds ratio, significance level and confidence interval			
	Heart Diseases	Hypertension	Diabetes	Cancer
Age-Group				
<30	0.43*** (0.36-0.52)	0.24*** (0.16-0.34)	0.27*** (0.18-0.40)	0.31*** (0.24-0.41)
30-39®				
40-49	1.83*** (1.55-2.17)	1.95*** (1.45-2.61)	2.34*** (1.70-3.23)	1.37** (1.08-1.75)
50-59	2.83*** (2.41-3.33)	2.83*** (2.15-3.74)	3.68*** (2.71-5.00)	1.15 (0.89-1.47)
60-69	3.89*** (3.30-4.59)	3.45*** (2.60-4.58)	4.26*** (3.11-5.81)	1.41*** (1.09-1.82)
70-79	4.61*** (3.85-5.51)	3.77*** (2.79-5.11)	3.71*** (2.64-5.22)	0.62*** (0.42-0.88)
80+	4.15*** (3.31-5.19)	3.72*** (2.58-5.37)	2.99*** (1.94-4.61)	0.33*** (0.17-0.63)
Sex				
Male®				
Female	0.83*** (0.76-0.90)	1.24*** (1.08-1.42)	1.47*** (1.27-1.71)	1.81*** (1.56-2.11)
Place of Residence				
Rural®				
Urban	1.30*** (1.19-1.42)	1.54*** (1.33-1.78)	1.28*** (1.10-1.49)	0.87 (0.74-1.03)
Education Level				
No Education®				
Primary	1.05 (0.94-1.17)	1.02 (0.85-1.21)	1.13 (0.94-1.36)	1.08 (0.88-1.31)
Secondary	1.15** (1.02-1.29)	1.01 (0.83-1.22)	1.10 (0.90-1.35)	0.89 (0.72-1.12)
Higher Secondary	1.16** (1.01-1.33)	0.96 (0.75-1.22)	1.00 (0.78-1.30)	1.52*** (1.20-1.93)
MPCE				
Poorest®				
Poorer	1.07 (0.92-1.23)	1.02 (0.90-1.44)	1.52*** (1.17-1.98)	0.92 (0.71-1.21)
Middle	1.08 (0.94-1.24)	1.10 (0.88-1.38)	1.26* (0.97-1.65)	0.98 (0.75-1.26)
Richer	1.22*** (1.07-1.40)	1.05 (0.84-1.32)	1.75*** (1.36-2.25)	1.17 (0.91-1.51)
Richest	1.28*** (1.12-1.48)	0.98 (0.77-1.24)	1.55*** (1.19-2.01)	1.92*** (1.50-2.45)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Decomposition of change in unconditional costs per hospitalization

Decomposition method has been used to understand the role of hospitalization rates and mean hospital costs in changing unconditional costs per hospitalization during 1995-2014. The variables used in decomposition analyses (Table 9) are unweighted cases. The unconditional costs per hospitalization in India have increased from US\$ 8 in 1995 to US\$ 41 in 2014. Decomposition results showed that, about half of the increase in unconditional costs per

hospitalization was due to increase in mean hospital costs (50.1 %) and the other half of the increase was due to hospitalization rates (49.1%).

Table 9: Indicators used for decomposing the change in unconditional costs per hospitalization in India during 1995-2014 (unweighted cases).

Indicators	1995	2014
Total Hospital Costs (US\$)	5144898	13848246
No. of Hospitalizations	26526	42662
Population at Risk	633408	335499
Mean Unconditional Costs	8	41
Mean Hospital Costs	194	325
Hospitalization Rate	0.04188	0.12716

Discussion

Demographic transition during the last two decades has altered the age structure of India’s population significantly. Size and share of the working population and elderly is growing exponentially. This age-structural transition is not only associated with demographic transition but is also linked to epidemiological transition, that is, the transition of disease pattern from communicable to non-communicable diseases. The early onset of non-communicable diseases (NCD) resulting from epidemiological transition is affecting working adults and the elderly equally and has become the leading cause of mortality and morbidity. Further, epidemiological transition not only increases the burden of diseases in a country but also imposes high financial hardship on its government and households. In this context, we examined the age pattern of hospitalization and costs of treatment in India during last the two decades. We have used two rounds of NSS survey data (52nd and 71st round). The 71st round of NSS data is the most recent concluded survey on morbidity and health care in India. The salient findings from our analysis are-

First, the age-pattern of hospitalization is similar to that of mortality and NCDs are the leading cause of hospitalization in India. With the exception of infants, hospitalization is an increasing function of age and recorded exponential growth beyond age 40. Hospitalization

rates have increased more than twice between 1995 and 2014 across all the age-groups and it was more prominent for infants, children and those 60 years and above. This increased hospitalization may be attributed to an array of factors; - rising morbidity over time, awareness of health benefit of the population, increasing income of the population, availability and accessibility of health services, besides others. Second, hospitalization due to communicable diseases, non-communicable and injuries has increased over time confirming the triple burden of diseases in India[24]. Hospitalization among children was primarily because of communicable disease whereas the NCDs were the leading cause of hospitalization for those aged 40+. Hospitalization due to heart diseases, hypertension, diabetes and cancer had more than tripled during the same period. Third, increasing hospitalization is associated with increasing costs over time irrespective of the diseases. However, costs per hospitalization were maximum among cancer patients. Fourth, costs per hospitalization for NCDs was three times that of communicable diseases. Besides, costs per hospitalization in private health care facilities were significantly higher than in public hospitals. Other studies have documented that the share of NCDs in out-of-pocket health expenditure incurred by households has increased over time in India[6] and the costs of NCDs are projected to increase in the future[24]. Many studies have shown that the high out-of-pocket health expenditure is catastrophic and the impoverishment impact in general and for poor households, in particular, pushes many families into the medical poverty trap[12, 17, 19, 34, 35].

During the last decade, there has been a systematic effort by the Government of India to improve health services and protect households from financial catastrophe. In 2008, the Government of India launched the Rashtriya Swasthya Bima Yojana (RSBY), a national health insurance scheme for poor. The main aim of RSBY was to provide health insurance coverage to the families (maximum up to five members) belonging to below poverty line

(BPL) and provide access to quality health care and protect them from catastrophic health expenditure. The scheme aimed to enhance poor people’s choice of health care provider by impanelling both public and private hospitals. It provides cashless insurance of up to US\$ 494 per family per year for hospitalization in any of the impanelled hospitals[36]. Studies have documented that the RSBY has been successful in reducing out-of-pocket expenditure (OOPE) and catastrophic impact on the families[37]. However, the coverage and insurance amount of the RSBY is very low and needs to be enhanced. The central government has introduced some other social health insurance schemes such as *Aam Aadmi Bima Yojana* (social security scheme for rural landless households), Universal Health Insurance Scheme (for poor families). The Central Government Health Scheme (CGHS) provides health care facilities for central government employees and pensioners and their dependents [38]. Besides, a number of schemes were launched by some states in India to provide health insurance primarily to poor families. For example, *Rajiv Aarogyasri* Scheme in Andhra Pradesh provides financial protection to the families living below poverty line up to US\$ 3292 a year for the treatment of serious ailments requiring hospitalization and surgery. About 938 treatments are covered under this scheme. Likewise, the Gujarat Government has launched *Mukhyamantri Amrutam* scheme which provides quality medical and surgical care to below poverty line families for catastrophic illnesses involving hospitalization, surgeries and therapies through an impanelled network of hospitals. The Chief Minister's Comprehensive Health Insurance Scheme in Tamil Nadu provides free medical and surgical treatment (up to US\$ 2469 per family per year) in government and private hospitals to the members of the family with an annual income less than US\$ 1185[39]. Although studies have documented that health insurance reduces the OOPE and catastrophic health spending, its coverage is still very low; less than 20% of the population is covered under any health insurance scheme in India[40]. Further, many health insurance schemes do not cover chronic

illnesses[41] and hence may not reduce the OOPE and catastrophic expenditure in certain households. Recently released National Health Policy, 2017 aimed to increase the central government spending from the current level of 1.15% to 2.5% of the gross domestic product (GDP) by 2025. Policy envisages attaining the highest possible level of health and well-being for all at all ages and providing affordable and universal access to good quality health care services without anyone facing financial catastrophe. It specifically stated its aim to reduce the proportion of household incurring catastrophic health expenditure from the current level by 25%, by 2025[42]. However, the success of the policy depends on how well it is implemented across the country, for this has always been a big hurdle in the Indian context.

Conclusion: During the last two decades, the hospitalization rate in India has increased across all age-groups. Costs per hospitalization had grown at least twice over time. Further, costs per hospitalization for NCDs were three times higher than that for communicable diseases in 2014 and thus imposing a high financial burden on the families. Though the catastrophic and impoverishment effect of out-of-pocket health expenditure was beyond the purview of this study, it has to be mentioned that many poor families are pushed towards utter poverty due to the high treatment cost. Increased public spending on health has a direct effect in reducing out-of-pocket health expenditure and could be helpful for many households to overcome the medical poverty trap. The Ministry of Health and Family Welfare, Government of India launched the “National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS)” in 2010. Initially, the programme was implemented in 100 districts covering 21 states and there was a proposal to expand it to cover all the districts across the country with special focus on strengthening infrastructure, human resource development, health promotion, early diagnosis, treatment and referral for prevention and control of cancer, diabetes, cardiovascular diseases and stroke[43].

Expansion of NPCDCS to all the districts may be helpful in averting many households from the medical poverty trap.

Footnotes

Contributors: AK and SKM have contributed a considerable share of their knowledge and effort. Both the authors (AK and SKM) designed and conceptualized the study. AK analysed the data and drafted the manuscript. SKM finalized the manuscript and gave critical comments on the study.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical Treatment of Experimental Subjects (Animal and Human): This article does not contain any studies with human or animal subjects performed by the author.

Informed Consent: The study used the data set that is available online in public domain; hence, there was no need to seek ethical consent to publish this study.

Funding: This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Data sharing and statement: No additional data are available.

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Figure Legends

Figure 1: Age pattern of death in India by cause of death classification, 2001-03

Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

Figure 3: Age pattern of hospitalization in India, 1995-2014

Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

Figure 6: Costs per hospitalization (in US\$) for communicable diseases, NCDs, injuries and other diseases in India, 1995-2014

Figure 7: Costs per hospitalization (in US\$) by type of diseases in India, 1995-2014

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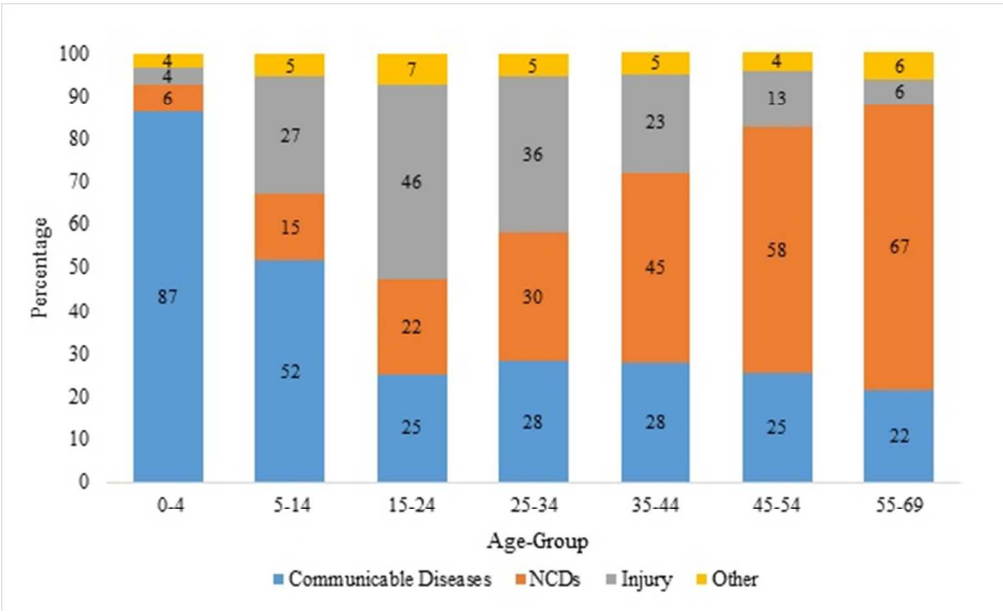


Figure 1: Age pattern of death in India by cause of death classification, 2001-03

49x30mm (300 x 300 DPI)

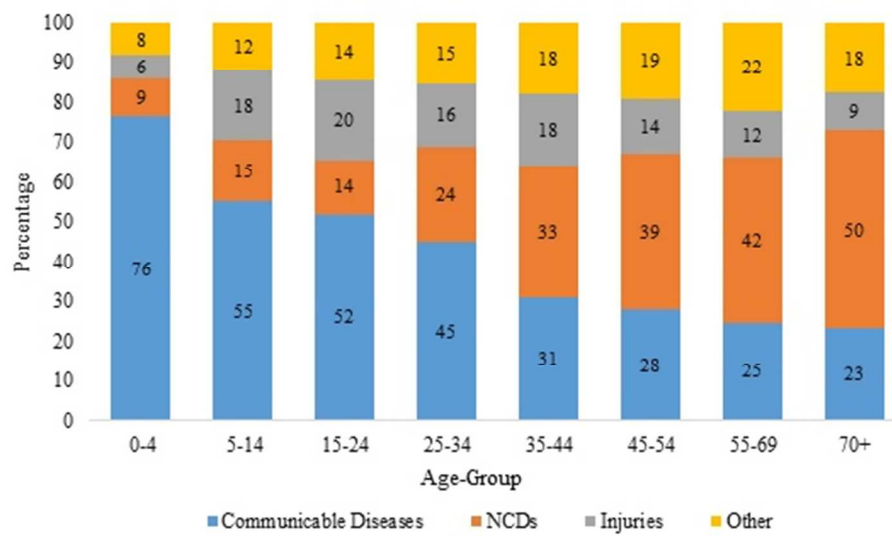


Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

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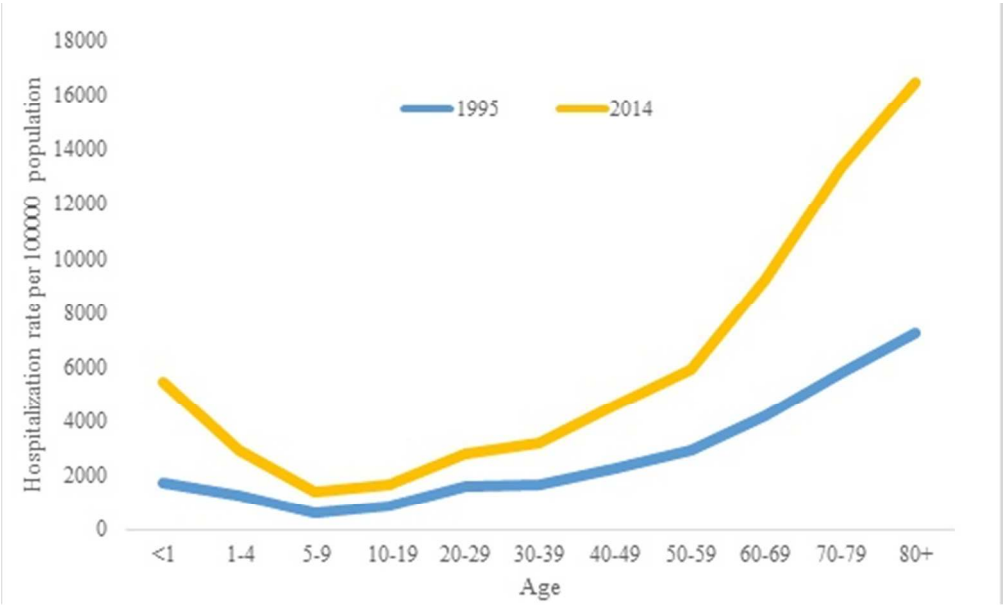


Figure 3: Age pattern of hospitalization in India, 1995-2014

46x28mm (300 x 300 DPI)

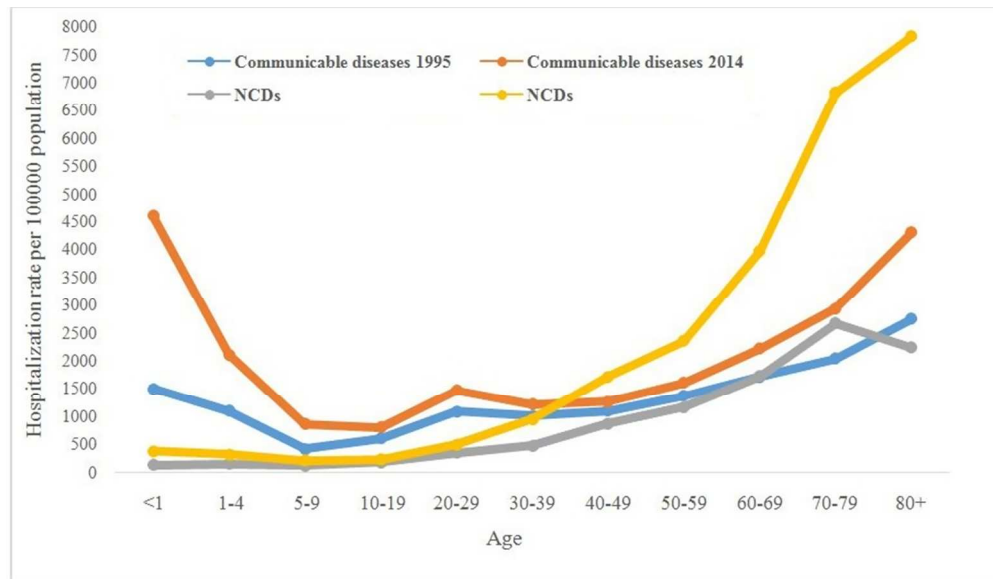


Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

77x44mm (300 x 300 DPI)

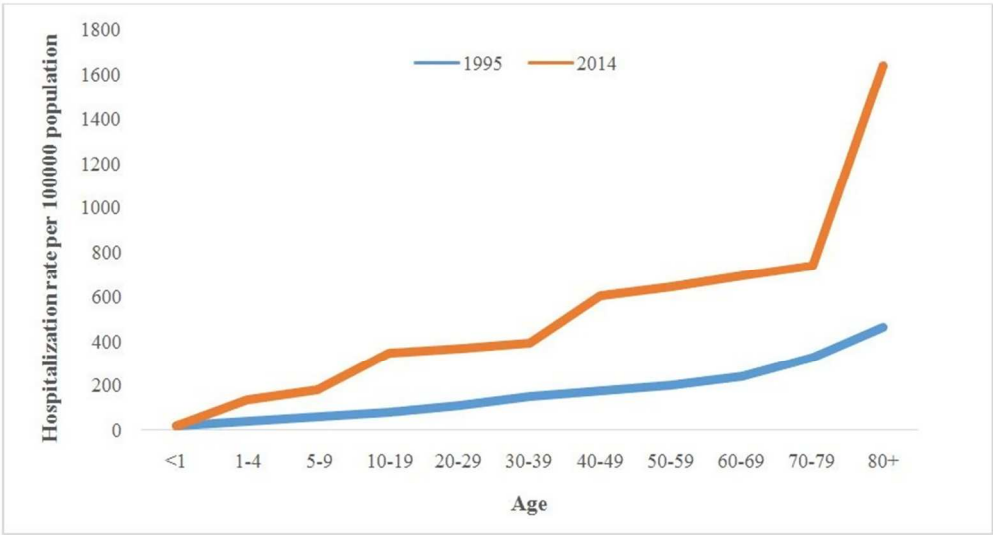


Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

75x41mm (300 x 300 DPI)

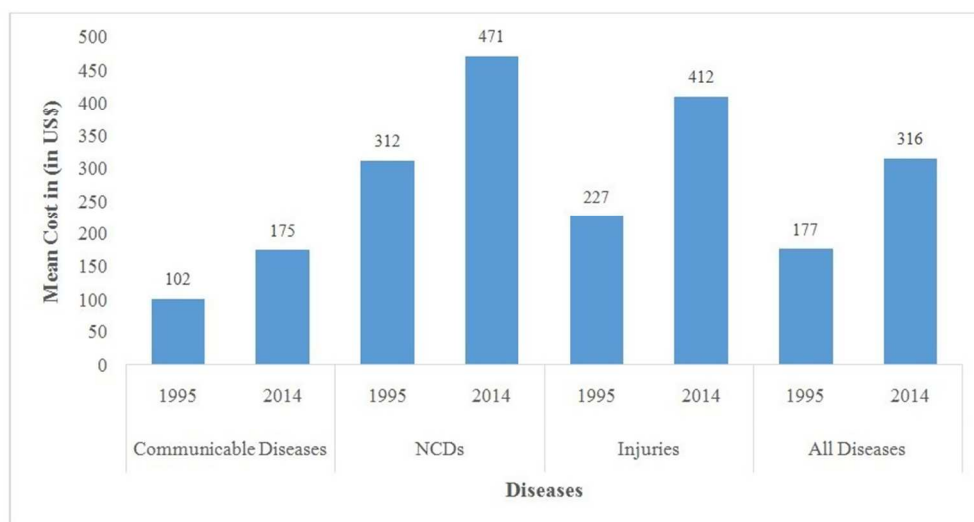


Figure 6: Costs per hospitalization (in US\$) for communicable diseases, NCDs, injuries and other diseases in India, 1995-2014

78x41mm (300 x 300 DPI)

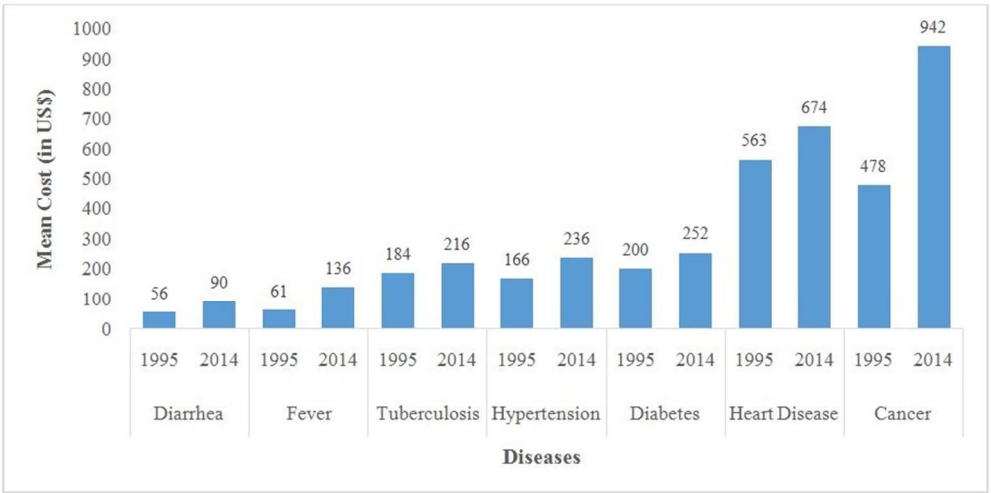


Figure 7: Costs per hospitalization (in US\$) by type of diseases in India, 1995-2014

77x39mm (300 x 300 DPI)

BMJ Open

Disease and Age Pattern of Hospitalization and Associated Costs in India: 1995-2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016990.R3
Article Type:	Research
Date Submitted by the Author:	20-Oct-2017
Complete List of Authors:	Kastor, Anshul; International Institute for Population Sciences, Fertility Studies Mohanty, Sanjay; INTERNATIONAL INSTITUTE FOR POPULATION SCIENCES, DEPARTMENT OF FERTILITY STUDIES
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	Disease and Age-pattern, Non-communicable Diseases, India, Cost of Hospitalization, Hospitalization Rate

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Title:

Disease and Age Pattern of Hospitalization and Associated Costs in India:
1995-2014

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Abstract

Objectives: The prime objective of this study is to examine the trends of disease and age pattern of hospitalization and associated costs in India during 1995-2014.

Design: Present study used nationally representative data on morbidity and health care from the 52nd (1995) and 71st (2014) rounds of the National Sample Survey.

Settings: A total of 120,942 and 65,932 households were surveyed in 1995 and 2014 respectively.

Measures: Descriptive statistics, logistic regression analyses and decomposition analyses were used in examining the changes in patterns of hospitalization and associated costs. Hospitalization rates and costs per hospitalization (out-of-pocket expenditure) were estimated for selected diseases and in four broad categories- communicable diseases, NCDs, injuries and others. All the costs are presented at 2014 prices in US dollars.

Results: Hospitalization rate in India has increased from 1661 in 1995 to 3699 in 2014 (per 100000 population). It has more than doubled across all age groups. Hospitalization among children was primarily because of communicable diseases, while NCDs were the leading cause of hospitalization for the 40+ population. Costs per hospitalization have increased from US\$ 177 in 1995 to US\$ 316 in 2014 (an increase of 79%). Costs per hospitalization for NCDs in 2014 were US\$ 471 compared to US\$ 175 for communicable diseases. It was highest for cancer inpatients (US\$ 942) followed by heart diseases (US\$ 674). Age is the significant predictor of hospitalization for all the selected diseases. Decomposition results showed that about three-fifth of the increase in unconditional costs per hospitalization was

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due to increase in mean hospital costs, and the other two-fifth was due to increase in hospitalization rates.

Conclusion: There has been more than two fold increase in hospitalization rates in India during the last two decades and significantly higher rates were observed among infants and older adults. Increasing hospitalization rates and costs per hospitalization are contributing substantially to the rising health care costs in India.

Strengths and limitations of this study

- This study provides disease specific hospitalization rates in a more comprehensive manner than ever using 11 age-groups.
- Change in disease specific costs per hospitalization has been estimated over past two decades.
- It decomposes the increase in unconditional costs per hospitalization by increase in mean hospitals costs and hospitalization rates.
- Study only uses the hospitalization cost which underestimates the total financial burden incurred by households on health care.

Introduction

Demographic transition and epidemiological transition have altered the age pattern of mortality and morbidity globally and nationally. While there has been significant progress in the reduction of infant and child mortality, adult mortality has shown varying patterns across regions and countries with deaths occurring at progressively older ages[1-2]. Non-communicable diseases (NCDs) are now the leading cause of mortality, hospitalization and

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3 disability in both developed and developing countries[3-4]. Social, economic and human loss
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5 due to the changing disease-pattern is profound and is affecting economic growth and
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7 development adversely across countries[5-6].
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11 The human capital models are based on the premise that health depreciates with age and can
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13 be augmented by investing in health, including medical care[7]. Medical care is positively
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15 associated with income, educational attainment, accessibility and availability of health
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17 services and the share of elderly population[8-11]. Age structural transition (due to
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19 demographic shift), increasing medical care, technological advancement and increase in the
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21 real cost of treatment are driving medical costs exponentially. Medical spending in
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23 developing countries is catastrophic for large households and families[12-20]. Though,
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25 publically funded health programs are covering primary health services, they are not
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27 equipped to meet the challenge of growing non-communicable diseases.
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33 Demographic change in India is marked by three key developments - falling fertility in the
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35 states, increase in longevity across age and improvement in child survival across
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37 socioeconomic groups. While the country is nearing to the replacement level of fertility,
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39 increase in longevity has been experienced across all age groups. Life expectancy at birth has
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41 increased from 59.4 years in 1991 to 66.1 years in 2011[21]. Under-five mortality has
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43 reduced by more than half during the same period and is now estimated at 55 per 1000 live
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45 births[22]. These positive developments are accompanied with a changing disease pattern
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47 (increase share of non-communicable diseases and injuries). NCDs have become the leading
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49 cause of mortality, disability and morbidity in India[23] and are projected to increase in the
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51 coming years[24].
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Evidence suggests that household health spending in India accounts for 71 per cent of total health spending[25] and is catastrophic to a large number of households. Hospitalization accounts for a large share of medical spending and the pattern of hospitalization vary across different ages. Besides, the growth rate of household health spending is faster than the growth rate of household economic well-being[26]. Though some attempt has been made to address the morbidity and disease pattern in India, there has been no study on the age pattern of hospitalization and associated costs in India. This paper aims to examine the trends in the age pattern of hospitalization and associated costs by selected diseases in India.

Methods

Data

The unit data from Schedule 25.0 of the 52nd (1995-96) and 71st rounds (2014) of the National Sample Survey (NSS) conducted by the National Sample Survey Organization (NSSO), Government of India are used in the analyses. These rounds of surveys are the only data bases that provide comprehensive and comparable information on the morbidity pattern and health care utilization covering the entire population in India. A total of 120,942 households and 633,408 individuals (629,888 alive and 3,520 death cases) were covered in 1995, and 65,932 households and 335,499 individuals (333,104 alive and 2,395 death cases) in 2014. The survey covered all states and union territories and the households were selected using multi-stage stratified sampling procedure. Details of the sampling designs and the survey findings are available in the reports of the respective rounds[27-28]. Schedule 25.0 of these two rounds has detailed information on types of ailment, duration of ailment, health care utilization, hospitalization, source of treatment (public/private) and expenditure incurred by each member of the sampled households on treatment of diseases/hospitalization. Data on medical expenditure on medicines, surgery, diagnostic tests, doctor’s fees and lodging

charges (direct expenditure) and expenditure on transport charges, and other charges indirect/non-medical expenses are available in both rounds of the survey. Our estimates on the costs of hospitalization include all direct and indirect expenditures incurred by household members on hospitalization.

Data on hospitalization (defined as an overnight stay in the hospital anytime) were collected in a reference period of 365 days and for out-patients (visit to a health care professional/health center and not an overnight stay) in a reference period of fifteen days. We have used only those cases that were hospitalized because they have the advantage of having been medically diagnosed and provided treatment. The number of hospitalized cases were 26,526 in 1995 and 42,869 in 2014. To compare the cost of hospitalization over time, expenditure is first adjusted to uniform base year (1987-88) and then adjusted at constant prices (2014 prices)[29]. All the estimates are presented in US Dollars (average exchange rate US\$ 1=INR 60.745) and at 2014 prices. Costs that we referred to in the analysis is out-of-pocket expenditure that was incurred during hospitalization.

Analytical Approach

For analytical purposes, we have classified the diseases into four broad categories, namely, communicable diseases, non-communicable diseases, injuries and other diseases similar to the classification of Cause of Death, India 2001-03[25]. Communicable diseases include all types of fever, filariasis, tetanus, diarrhoea, jaundice, respiratory diseases, anaemia, tuberculosis, HIV/AIDS and other sexually transmitted diseases, while non-communicable diseases include cancer, diabetes, heart diseases, hypertension, asthma, musculoskeletal, genito-urinary, psychiatric and neurological illnesses. Disease specific analyses have been carried out by considering the frequencies and importance of the diseases. The specific

diseases covered are fever, diarrhoea, tuberculosis, cancer, heart diseases, hypertension, diabetes and injuries. A total of eleven broad age-groups, namely, <1, 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+ are used in the analysis. Analyses have been limited to the national level.

Hospitalization rate, descriptive statistics, decomposition method and logistic regressions are used in the analyses. Hospitalization rate is defined as the number of spells of hospitalization anytime during the one year preceding the survey of the population exposed to risk[30].

$$\text{Hospitalization Rate} = \frac{\text{Total Number of Spells of Hospitalization during last 365 days}}{\text{Population Exposed to Risk}} * 100000$$

Hospitalization rate is expressed per 100,000 population. Costs per hospitalization by diseases and age groups are presented over time. Bivariate analyses were carried out to understand the differentials and variations in hospitalization and associated cost over time.

We have used the decomposition method to understand the role of mean hospital costs and hospitalization rates in affecting the change in unconditional costs per hospitalization over time. A detailed description and review of the decomposition method and its underlying assumption can be found elsewhere [31-33]. The advantage of using this method is that we can attribute the changes in unconditional costs per hospitalization to the change in hospitalization rates and change in mean hospital costs. The decomposition model is given as;

$$\text{Unconditional costs [t+1]} - \text{Unconditional costs [t]} = (\text{Mean hospital costs[t+1]} - \text{Mean hospital costs[t]} * \text{Hospitalization rates [t+1]}) + (\text{Hospitalization rates[t+1]} - \text{Hospitalization rates[t]} * \text{Mean hospital costs [t]})$$

Where, [t] is “Year 1995”

[t+1] is “Year 2014”

The first term in the above decomposition method is the changes in costs due to hospital costs and the second term is change in costs due to hospitalization rates. All the indicators used in this decomposition method are weighted. Additionally, all the results presented in the paper are based on analytical weights given by the NSSO.

A set of logistic regression analyses was carried out to understand the role of age-pattern on hospitalization. The dependent variables used are hospitalization for specific diseases or group of morbidities and the independent variables used are age-group, sex, place of residence (rural-urban), educational attainment and monthly per capita consumption (MPCE) quintile. The model specification is given below:

$$\ln(Y)_{it} = a + b1*(Age)_{it} + b2*(Sex)_{it} + b3*(POR)_{it} + b4*(Education)_{it} + b5*(MPCE)_{it} \dots\dots\dots (1)$$

Where Y is the binary variable, that is, whether hospitalized or not for disease i (Yes=1, No=0) at time t , Age is the age-group, POR is the place of residence (rural or urban), $Education$ is the level of educational attainment of the person and $MPCE$ is the monthly per capita consumption expenditure of the household.

Results

Age-pattern of mortality and hospitalization in India has been presented in Figure 1 and 2 respectively. While the age pattern of mortality is taken from the Cause of Death Report, India 2001-03, the age pattern of hospitalization for 2014 has been estimated from NSS data. In general, the age pattern of mortality and hospitalization by disease are similar in India. For children below 15 years of age, communicable diseases are the leading cause of death

and hospitalization. Injury is the leading cause of death for those in the age group 25-34, while communicable diseases are the leading cause of hospitalization. NCDs are the leading cause of death and hospitalization in India for those who are aged 35+.

[Fig 1 to be embedded here]

[Fig 2 to be embedded here]

Table 1 presents the profile of the households and individuals surveyed in 1995-96 and in 2014. Mean age of the population has increased by four years, while the average household size has declined by 0.7 persons over the last two decades. The proportion of children (0-14 years) has declined, while that of the elderly population has increased. Educational attainment has improved over time. Monthly per capita consumption expenditure (MPCE), an indicator of household economic well-being, has increased by 37% (at 2014 constant price). However, rural-urban differences in MPCE have remained large over time.

Table 1: Sample profile of individuals and households in India, 1995-2014

Variable	1995	2014
Mean Age (in years)	25.0	28.5
Sex Ratio (Females per 1000 Males)	939	943
Urbanization (%)	24.2	30.0%
Average Household Size	6.23	5.54
Age Distribution (%)		
Child Population (0-14)	36.8	29.0
Working Age (15-59)	57.7	63.2
Elderly (60+)	5.5	7.8
Education Level		
No Education	48.9	31.5

Primary	29.0	30.3
Secondary	16.4	23.9
Higher Secondary	5.7	14.3
Average Monthly Per Capita Consumption Expenditure (US\$)	20	27
Average Monthly Per Capita Consumption Expenditure (Rural) (US\$)	16	21
Average Monthly Per Capita Consumption Expenditure (Urban) (US\$)	30	40
Number of Households	120942	65932
Number of persons	629888	333104

[Fig 3 to be embedded here]

Fig 3 presents the hospitalization rates in 1995 and 2014 across broad age groups in India. Age pattern of hospitalization rate has shifted upward over time. The overall hospitalization rate (per 100,000 population) has increased more than twice, from 1661 in 1995 to 3699 in 2014. Hospitalization rates of infants (<1 years age) have increased thrice during the period, lowest in the age group 5-9 and lower till age 30. Beyond age 40, hospitalization rates increased at a faster rate and by age 80, the rates were about five times higher than that of the overall population.

[Fig 4 to be embedded here]

During 1995-2014, the hospitalization rates for communicable diseases have increased by 47% (from 958 in 1995 to 1412 in 2014) and by 137% for non-communicable diseases (482 to 1142) (Table 2). The age-patterns of hospitalization rates due to communicable and non-communicable diseases have shown interesting trends (Fig 4). In 1995, hospitalization due to communicable diseases was higher than the NCDs in eight of the eleven specified age groups (except 50-59, 70-79 and 80+). By 2014, hospitalization due to NCDs was higher in five of the eleven specified age groups (higher for all ages beyond 40). This suggests that NCDs are now advancing and affecting the younger age group. Hospitalization due to communicable diseases has shown a “U” shaped curve in both the periods and the curve has shifted over time suggesting increasing hospitalization (Fig 4). It had increased among the children and elderly and was highest among infants. Hospitalization beyond age 40 was primarily due to NCDs. Hospitalization due to injuries had also increased across all age groups and showed an increasing pattern (Fig 5). Further, hospitalization due to other diseases had also increased over time especially due to senility among the elderly.

Table 2: Age pattern of hospitalization rate (per 100000 population) by communicable disease, non-communicable diseases, injuries and other diseases in India, 1995-2014

Age	Hospitalization Rate per 100000 Population										Percentage Change (1995-2014)				
	Communicable Disease		Non-Communicable Disease		Injuries		Senility/ Other Diseases		All Diseases		Communicable Disease	Non-Communicable Disease	Injuries	Senility/ Other Diseases	All Disease
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014					
<1	1496	4594	123	372	18	18	107	447	1745	5431	207	201	0	316	211
1-4	1087	2108	150	309	40	132	28	357	1306	2907	94	106	228	1179	123
5-9	410	853	114	202	57	177	30	186	610	1418	108	78	213	515	132
10-19	595	799	175	227	79	344	32	277	881	1646	34	30	335	759	87
20-29	1079	1466	347	486	109	367	47	481	1583	2799	36	40	236	915	77
30-39	1004	1205	469	940	149	391	71	665	1692	3201	20	100	163	832	89
40-49	1093	1254	863	1713	174	602	116	1010	2246	4579	15	98	246	770	104
50-59	1370	1601	1161	2346	198	642	237	1349	2965	5938	17	102	225	469	100
60-69	1706	2214	1726	3961	240	690	549	2351	4221	9217	30	130	188	328	118
70-79	2036	2931	2662	6816	325	739	789	2893	5811	13379	44	156	128	267	130
80+	2744	4299	2235	7829	462	1637	1804	2701	7245	16466	57	250	255	50	127
All Ages	958	1412	482	1141	116	411	106	735	1661	3699	47	137	255	596	123

[Fig 5 to be embedded here]

Table 3 presents the hospitalization rates (per 100,000 population) for fever, diarrhoea and tuberculosis in 1995 and 2014. Hospitalization due to fever had increased for all age groups and showed no pattern with age in either time points. The increase in hospitalization was similar for all age groups. In 2014, hospitalization due to fever was highest for the 80+ age group (1169) followed by children in the 1-4 age group (1157). During 1995-2014, hospitalization due to diarrhoea had decreased from 159 to 124. Hospitalization for diarrhoea had declined for all the age-groups except among children under five years. In 2014, hospitalization due to diarrhoea was highest for infants followed by children in the 1-4 age group. Similarly, there was a modest increase in hospitalization due to tuberculosis (from 41 to 50) and this increase was minimal among all hospitalization cases. Age-pattern of tuberculosis suggests a decreasing trend across all ages beyond 30, while it showed an increasing pattern for the age group below 30 years. Table 4 presents the hospitalization rate due to four specific non-communicable diseases, namely, heart diseases, hypertension, diabetes and cancer. Hospitalization due to cancer, heart diseases, hypertension and diabetes had increased more than threefold during the same period. Hospitalization due to these four NCDs is positively associated with age. Hospitalization due to each of these four diseases had increased for each specified age group. The increase was equally high among the working age group (30-69) suggesting that it was significantly affecting the working population. In 1995, the hospitalization rates of cancer (187) and heart diseases (577) was highest in the age group 70-79 and in 2014 it was highest among the 80+ (626 and 3402 respectively). Hospitalization rates for hypertension (954) and diabetes (614) were highest among those in the 70-79 age group.

Table 3: Age pattern of hospitalization rate (per 100000 population) by fever, diarrhoea, tuberculosis and injuries in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population						Percentage Change (1995-2014)		
	Fever		diarrhoea		Tuberculosis		Fever	Diarrhoea	Tuberculosis
	1995	2014	1995	2014	1995	2014			
<1	260	864	213	425	5	0	233	100	-100
1-4	306	1157	364	421	9	40	278	16	351
5-9	124	578	109	79	7	14	366	-28	91
10-19	187	512	91	45	12	24	174	-51	109
20-29	204	544	102	63	33	45	166	-38	33
30-39	196	549	142	97	64	35	181	-31	-46
40-49	190	593	170	82	68	83	212	-52	20
50-59	263	868	221	150	97	89	230	-32	-8
60-69	312	940	206	214	143	89	201	4	-37
70-79	307	928	339	311	121	81	202	-8	-33
80+	338	1169	716	399	108	584	246	-44	443
All Ages	208	659	159	124	41	50	216	-22	24

Table 4: Age pattern of hospitalization rate (per 100000 population) by heart diseases, hypertension, diabetes and cancer in India, 1995-2014

Age	Prevalence of Hospitalization per 100000 Population								Percentage Change (1995-2014)			
	Heart Disease		Hypertension		Diabetes		Cancer		Heart Diseases	Hypertension	Diabetes	Cancer
	1995	2014	1995	2014	1995	2014	1995	2014				
<30	21	44	3	11	1	7	7	16	110	267	600	129
30-39	39	129	16	43	4	27	27	70	233	166	543	157
40-49	156	402	63	170	30	88	61	142	158	171	198	131
50-59	284	664	133	285	60	193	67	216	134	115	224	224
60-69	331	1280	202	479	119	378	127	407	287	137	216	221
70-79	577	2493	223	954	245	614	187	283	332	328	150	51
80+	309	3402	253	836	34	562	81	626	1002	231	1561	673
All Ages	78	295	32	110	17	73	28	87	276	239	331	216

Costs Per Hospitalization for Communicable and Non-Communicable Diseases

Figure 6 shows the costs per hospitalization for communicable diseases, NCDs, injuries and all diseases in 1995 and 2014. Costs per hospitalization were US\$ 177 in 1995, which increased to US\$ 316 (by 79 percent) in 2014. Expectedly, NCDs had the highest costs per hospitalization compared to all other specified categories during both the surveys. For example, costs per hospitalization for NCDs (US\$ 312 in 1995 and US\$ 471 in 2014) was about three times higher than that of communicable diseases (US\$ 102 in 1995 and US\$ 175 in 2014) in both the points. Noticeably, expenditure on injuries was also very high (US\$ 412 in 2014). During 1995-2014, costs per hospitalization for communicable diseases had increased by 72 per cent, while that of communicable diseases had increased by 51 per cent at constant prices. Both communicable and NCDs did not show any pattern in the cost of hospitalization with respect to age.

[Fig 6 to be embedded here]

[Fig 7 to be embedded here]

Table 5 presents costs per hospitalization by public and private hospitals for each specified disease at 2014 prices. In 2014, costs per hospitalization for cancer was most expensive (US\$ 941) followed by heart disease (US\$ 674) (Fig 7). This pattern holds true for both public and private health centres. It was lowest for diarrhoea followed by fever. Notably, costs per hospitalization for each of the diseases in private health centres was about two to three times higher than that in public health centres in both periods. Costs per hospitalization for all the specified diseases had increased over time. Further, costs per hospitalization in public

Table 5: Costs per hospitalization in public and private health centers by disease in India, 1995-2014

Diseases	Change in mean cost of hospitalization (in US\$) by public-private expenditure during 1995-2014					
	1995		2014		% Change (1995-2014)	
	Public	Private	Public	Private	Public	Private
Communicable Diseases	66	143	73	250	10.6	74.9
NCDs	196	403	202	607	3.3	50.9
Injuries	165	306	143	615	-13.4	101.1
Fever	44	77	52	186	17.7	142.0
Diarrhoea	32	88	36	155	13.5	76.1
Tuberculosis	133	282	110	398	-17.5	41.1
Heart Diseases	196	823	247	913	25.8	11.0
Hypertension	110	203	68	338	-38.6	66.2
Diabetes	131	254	91	326	-30.1	28.3
Cancer	305	789	466	1257	52.8	59.3
All Diseases	114	244	125	435	9.3	77.9

hospitals have declined for hypertension, diabetes, tuberculosis and injuries. Hospitalization costs were not only expensive in private health centres but also recorded a faster increase for each of the diseases. Increase in the costs per hospitalization in private health centres had increased the gap between public-private expenditure over time. For example, in 1995, costs per hospitalization for communicable diseases in private hospitals was twice higher than that in public hospitals (US\$ 66 and US\$ 143 respectively), whereas the difference increased to 3.5 times (US\$ 73 and US\$ 250 respectively) in 2014. Similarly, in 1995-96, per capita cost of hospitalization for NCDs in private hospitals was twice higher than that in public hospitals (US\$ 196 and US\$ 403 respectively), whereas the difference increased by threefold (US\$ 202 and US\$ 607 respectively) in 2014.

Multivariate Analyses

Table 6 presents the odds of hospitalization for communicable diseases, NCDs and injuries and their confidence interval. Hospitalization for a specific category of disease (for instance, communicable diseases) was taken as 1 and 0 for hospitalization of all other diseases. The set

of explanatory variables are age, sex, place of residence, educational attainment and MPCE quintile. Estimates were obtained for 1995 and 2014 and results were presented for 2014 as the patterns were similar over time. Age, sex and place of residence are significant predictors of communicable diseases. With respect to age, the age-group 30-39 is the reference group because NCDs showed a steady increasing pattern beyond this age-group. Hospitalization for communicable diseases was significantly higher among younger ages compared to older age groups and the odds of hospitalization decrease with age. For example, the odds of hospitalization among children in the age group 1-4 were six times higher than those in the 30-39 age group. Compared to males, females were significantly more likely to be hospitalized for

Table 6: Results of logistic regression for hospitalization due to communicable, non-communicable diseases and injuries in India, 2014

Covariates	Odds ratio, significance level and confidence interval		
	Communicable Diseases	NCDs	Injuries
Age-Group			
<1	11.04*** (9.08-13.42)	0.17*** (0.13-0.23)	0.16*** (0.11-0.23)
1-4	5.65*** (5.03-6.35)	0.27*** (0.23-0.31)	0.33*** (0.27-0.40)
5-9	3.06*** (2.75-3.48)	0.38*** (0.32-0.44)	0.70*** (0.60-0.83)
10-19	1.85*** (1.70-2.02)	0.44*** (0.39-0.48)	1.05 (0.94-1.17)
20-29	1.79*** (1.66-1.94)	0.55*** (0.50-0.60)	1.02 (0.92-1.13)
30-39®			
40-49	0.69*** (0.63-0.74)	1.45*** (1.34-1.57)	0.92* (0.83-1.02)
50-59	0.59*** (0.55-0.64)	1.71*** (1.60-1.85)	0.76*** (0.68-0.84)
60-69	0.53*** (0.49-0.58)	2.05*** (1.89-2.24)	0.51*** (0.45-0.58)
70-79	0.55*** (0.50-0.62)	2.14*** (1.94-2.36)	0.51*** (0.44-0.59)
80+	0.69*** (0.59-0.80)	2.05*** (1.78-2.35)	0.69*** (0.56-0.85)
Sex			
Male®			
Female	1.41*** (1.35-1.47)	1.03 (0.99-1.09)	0.45*** (0.42-0.48)
Place of Residence			
Rural®			
Urban	0.97 (0.93-1.02)	1.15*** (1.09-1.20)	0.86*** (0.81-0.92)
Education Level			
No Education®			

Primary	1.04(0.97-1.10)	0.99(0.93-1.02)	0.96(0.88-1.05)
Secondary	0.94*(0.88-1.01)	1.01(0.94-1.08)	1.09*(0.99-1.19)
Higher Secondary	0.88*** (0.81-0.95)	0.95(0.88-1.03)	1.20*** (1.08-1.33)
MPCE			
Poorest®			
Poorer	0.95(0.89-1.01)	1.10*** (1.02-1.19)	1.00(0.92-1.10)
Middle	0.94*(0.88-1.01)	1.11*** (1.03-1.19)	1.05(0.96-1.15)
Richer	0.90*** (0.84-0.96)	1.21*** (1.13-1.30)	1.05(0.95-1.15)
Richest	0.79*** (0.73-0.85)	1.41** (1.30-1.52)	1.07(0.97-1.19)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

communicable diseases. Age, sex, place of residence and educational attainment were significant predictors of NCDs. The odds of hospitalization for NCDs were for all ages below 30 and higher for all age groups above 40 than that for the reference age group. Likelihood of hospitalization increased with age, that is, beyond age 40 - 1.45 for the age group 40-49, 1.71 for 50-59 and 2.05 for 60-69. Urban residents were significantly more likely to be hospitalized for NCDs than their rural counterparts. Age-pattern of hospitalization of injuries was distinct; it affected those in the age group 30-39 significantly and was lower for all other age groups. The odds of hospitalization decreased with age beyond the reference age group. Females were significantly less likely to be hospitalized for injuries compared to males.

Table 7 presents the odds ratio and confidence interval for three specific diseases, namely- fever, diarrhoea and tuberculosis. Odds of hospitalization for fever and diarrhoea were significantly higher for the younger age group and lower for the older age group. Females were significantly more likely to be hospitalized for fever and diarrhoea. Chances of hospitalization for fever increased with MPCE quintile and decreased for diarrhoea. In the case of tuberculosis, the odds of hospitalization for the older age group were not statistically significant (except 70-79 age group); those in the younger age groups were lesser likely to be hospitalized compared to those in the 30-39 age group. Likelihood of hospitalization for

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females and urban residents were significantly lower compared to males and rural residents respectively.

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Table 7: Results of logistic regression for hospitalization of fever, diarrhoea and tuberculosis in India 2014

Covariates	Odds ratio, significance level and confidence interval		
	Fever	Diarrhoea	Tuberculosis
Age-Group			
<1	1.65*** (1.30-2.09)	3.81*** (2.76-5.26)	
1-4	2.44*** (2.13-2.81)	4.62*** (3.71-5.76)	0.23*** (0.13-0.40)
5-9	2.53*** (2.18-2.93)	2.27*** (1.78-2.89)	0.33*** (0.18-0.59)
10-19	2.03*** (1.81-2.28)	1.30** (1.04-1.62)	0.73 (0.51-1.07)
20-29	1.38*** (1.23-1.55)	1.02 (0.81-1.28)	1.29 (0.92-1.79)
30-39®			
40-49	0.69*** (0.62-0.78)	0.77** (0.62-0.97)	1.17 (0.86-1.60)
50-59	0.54*** (0.49-0.61)	0.76** (0.60-0.95)	0.76 (0.54-1.06)
60-69	0.34*** (0.29-0.38)	0.88 (0.69-1.11)	0.86 (0.61-1.21)
70-79	0.27*** (0.23-0.33)	0.70** (0.52-0.94)	0.53*** (0.33-0.85)
80+	0.26*** (0.20-0.33)	0.62** (0.40-0.95)	1.18 (0.72-1.92)
Sex			
Male®			
Female	1.45*** (1.36-1.54)	1.33*** (1.20-1.47)	0.65*** (0.54-0.79)
Place of Residence			
Rural®			
Urban	0.93** (0.87-0.99)	1.13** (1.01-1.25)	0.64*** (0.53-0.78)
Education Level			
No Education®			
Primary	1.08* (0.99-1.18)	0.94 (0.81-1.10)	0.69*** (0.54-0.87)
Secondary	0.94 (0.85-1.03)	0.90 (0.76-1.08)	0.60*** (0.46-0.78)
Higher Secondary	0.87** (0.78-0.98)	0.80 (0.64-1.00)	0.48*** (0.34-0.68)
MPCE			
Poorest®			
Poorer	1.07 (0.97-1.17)	0.96 (0.83-1.11)	0.59*** (0.45-0.76)
Middle	1.16*** (1.06-1.27)	0.81*** (0.70-0.94)	0.58*** (0.45-0.75)
Richer	1.08 (0.98-1.19)	0.66*** (0.56-0.77)	0.65*** (0.50-0.84)
Richest	1.03*** (0.92-1.14)	0.55*** (0.46-0.66)	0.52*** (0.37-0.71)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Odds of hospitalization for tuberculosis decrease with educational attainment and MPCE quintile. Table 8 presents the odds ratio for hospitalization of heart diseases, hypertension, diabetes and cancer. Likelihood of being hospitalized was significantly lower among those below 30 years for all the selected diseases. The chances of hospitalization for heart diseases, hypertension and diabetes increased with age, while hospitalization due to cancer was

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significantly lower among those aged 70+ compared to the reference category. Females had lower odds of hospitalization due to heart diseases whilst there were higher chances of them being hospitalized for hypertension, diabetes and cancer. Odds of hospitalization due to diabetes (OR 1.55) and cancer (OR 1.92) were higher among the richest compared to those in the poorest MPCE quintile.

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Table 8: Results of logistic regression for hospitalization of heart diseases, hypertension, diabetes and cancer in India 2014

Covariates	Odds ratio, significance level and confidence interval			
	Heart Diseases	Hypertension	Diabetes	Cancer
Age-Group				
<30	0.43*** (0.36-0.52)	0.24*** (0.16-0.34)	0.27*** (0.18-0.40)	0.31*** (0.24-0.41)
30-39®				
40-49	1.83*** (1.55-2.17)	1.95*** (1.45-2.61)	2.34*** (1.70-3.23)	1.37** (1.08-1.75)
50-59	2.83*** (2.41-3.33)	2.83*** (2.15-3.74)	3.68*** (2.71-5.00)	1.15 (0.89-1.47)
60-69	3.89*** (3.30-4.59)	3.45*** (2.60-4.58)	4.26*** (3.11-5.81)	1.41*** (1.09-1.82)
70-79	4.61*** (3.85-5.51)	3.77*** (2.79-5.11)	3.71*** (2.64-5.22)	0.62*** (0.42-0.88)
80+	4.15*** (3.31-5.19)	3.72*** (2.58-5.37)	2.99*** (1.94-4.61)	0.33*** (0.17-0.63)
Sex				
Male®				
Female	0.83*** (0.76-0.90)	1.24*** (1.08-1.42)	1.47*** (1.27-1.71)	1.81*** (1.56-2.11)
Place of Residence				
Rural®				
Urban	1.30*** (1.19-1.42)	1.54*** (1.33-1.78)	1.28*** (1.10-1.49)	0.87 (0.74-1.03)
Education Level				
No Education®				
Primary	1.05 (0.94-1.17)	1.02 (0.85-1.21)	1.13 (0.94-1.36)	1.08 (0.88-1.31)
Secondary	1.15** (1.02-1.29)	1.01 (0.83-1.22)	1.10 (0.90-1.35)	0.89 (0.72-1.12)
Higher Secondary	1.16** (1.01-1.33)	0.96 (0.75-1.22)	1.00 (0.78-1.30)	1.52*** (1.20-1.93)
MPCE				
Poorest®				
Poorer	1.07 (0.92-1.23)	1.02 (0.90-1.44)	1.52*** (1.17-1.98)	0.92 (0.71-1.21)
Middle	1.08 (0.94-1.24)	1.10 (0.88-1.38)	1.26* (0.97-1.65)	0.98 (0.75-1.26)
Richer	1.22*** (1.07-1.40)	1.05 (0.84-1.32)	1.75*** (1.36-2.25)	1.17 (0.91-1.51)
Richest	1.28*** (1.12-1.48)	0.98 (0.77-1.24)	1.55*** (1.19-2.01)	1.92*** (1.50-2.45)

® Represents reference category, P-value: - *** < 0.01, ** < 0.05 & * < 0.1

Decomposition of change in unconditional costs per hospitalization

Decomposition method has been used to understand the role of hospitalization rates and mean hospital costs in changing unconditional costs per hospitalization during 1995-2014. The unconditional costs per hospitalization in India have increased from US\$ 2.9 in 1995 to US\$ 11.6 in 2014 (Table 9). Decomposition results showed that, about three-fifth of the increase in unconditional costs per hospitalization was due to increase in mean hospital costs (58.8%) and the other two-fifth of the increase was due to hospitalization rates (41.2%).

Table 9: Indicators used for decomposing the change in unconditional costs per hospitalization in India during 1995-2014.

Indicators	1995	2014
Mean Unconditional Costs	2.9	11.6
Mean Hospital Costs	177	316
Hospitalization Rate	0.01661	0.03699

Discussion

Demographic transition during the last two decades has altered the age structure of India’s population significantly. Size and share of the working population and elderly is growing exponentially. This age-structural transition is not only associated with demographic transition but is also linked to epidemiological transition, that is, the transition of disease pattern from communicable to non-communicable diseases. The early onset of non-communicable diseases (NCD) resulting from epidemiological transition is affecting working adults and the elderly equally and has become the leading cause of mortality and morbidity. Further, epidemiological transition not only increases the burden of diseases in a country but also imposes high financial hardship on its government and households. In this context, we examined the age pattern of hospitalization and costs of treatment in India during last the two decades. We have used two rounds of NSS survey data (52nd and 71st round). The 71st round of NSS data is the most recent concluded survey on morbidity and health care in India. The salient findings from our analysis are-

First, the age-pattern of hospitalization is similar to that of mortality and NCDs are the leading cause of hospitalization in India. With the exception of infants, hospitalization is an increasing function of age and recorded exponential growth beyond age 40. Hospitalization rates have increased more than twice between 1995 and 2014 across all the age-groups and it was more prominent for infants, children and those 60 years and above. This increased hospitalization may be attributed to an array of factors; - rising morbidity over time, awareness of health benefit of the population, increasing income of the population,

availability and accessibility of health services, besides others. Second, hospitalization due to communicable diseases, non-communicable and injuries has increased over time confirming the triple burden of diseases in India[24]. Hospitalization among children was primarily because of communicable disease whereas the NCDs were the leading cause of hospitalization for those aged 40+. Hospitalization due to heart diseases, hypertension, diabetes and cancer had more than tripled during the same period. Third, increasing hospitalization is associated with increasing costs over time irrespective of the diseases. However, costs per hospitalization were maximum among cancer patients. Fourth, costs per hospitalization for NCDs was three times that of communicable diseases. Besides, costs per hospitalization in private health care facilities were significantly higher than in public hospitals. Other studies have documented that the share of NCDs in out-of-pocket health expenditure incurred by households has increased over time in India[6] and the costs of NCDs are projected to increase in the future[24]. Many studies have shown that the high out-of-pocket health expenditure is catastrophic and the impoverishment impact in general and for poor households, in particular, pushes many families into the medical poverty trap[12, 17, 19, 34, 35].

During the last decade, there has been a systematic effort by the Government of India to improve health services and protect households from financial catastrophe. In 2008, the Government of India launched the Rashtriya Swasthya Bima Yojana (RSBY), a national health insurance scheme for poor. The main aim of RSBY was to provide health insurance coverage to the families (maximum up to five members) belonging to below poverty line (BPL) and provide access to quality health care and protect them from catastrophic health expenditure. The scheme aimed to enhance poor people's choice of health care provider by impanelling both public and private hospitals. It provides cashless insurance of up to US\$ 494 per family per year for hospitalization in any of the impanelled hospitals[36]. Studies

have documented that the RSBY has been successful in reducing out-of-pocket expenditure (OOPE) and catastrophic impact on the families[37]. However, the coverage and insurance amount of the RSBY is very low and needs to be enhanced. The central government has introduced some other social health insurance schemes such as *Aam Aadmi Bima Yojana* (social security scheme for rural landless households), Universal Health Insurance Scheme (for poor families). The Central Government Health Scheme (CGHS) provides health care facilities for central government employees and pensioners and their dependents [38]. Besides, a number of schemes were launched by some states in India to provide health insurance primarily to poor families. For example, *Rajiv Aarogyasri* Scheme in Andhra Pradesh provides financial protection to the families living below poverty line up to US\$ 3292 a year for the treatment of serious ailments requiring hospitalization and surgery. About 938 treatments are covered under this scheme. Likewise, the Gujarat Government has launched *Mukhyamantri Amrutam* scheme which provides quality medical and surgical care to below poverty line families for catastrophic illnesses involving hospitalization, surgeries and therapies through an impanelled network of hospitals. The Chief Minister's Comprehensive Health Insurance Scheme in Tamil Nadu provides free medical and surgical treatment (up to US\$ 2469 per family per year) in government and private hospitals to the members of the family with an annual income less than US\$ 1185[39]. Although studies have documented that health insurance reduces the OOPE and catastrophic health spending, its coverage is still very low; less than 20% of the population is covered under any health insurance scheme in India[40]. Further, many health insurance schemes do not cover chronic illnesses[41] and hence may not reduce the OOPE and catastrophic expenditure in certain households. Recently released National Health Policy, 2017 aimed to increase the central government spending from the current level of 1.15% to 2.5% of the gross domestic product (GDP) by 2025. Policy envisages attaining the highest possible level of health and well-being

for all at all ages and providing affordable and universal access to good quality health care services without anyone facing financial catastrophe. It specifically stated its aim to reduce the proportion of household incurring catastrophic health expenditure from the current level by 25%, by 2025[42]. However, the success of the policy depends on how well it is implemented across the country, for this has always been a big hurdle in the Indian context.

Conclusion: During the last two decades, the hospitalization rate in India has increased across all age-groups. Costs per hospitalization had grown at least twice over time. Further, costs per hospitalization for NCDs were three times higher than that for communicable diseases in 2014 and thus imposing a high financial burden on the families. Though the catastrophic and impoverishment effect of out-of-pocket health expenditure was beyond the purview of this study, it has to be mentioned that many poor families are pushed towards utter poverty due to the high treatment cost. Increased public spending on health has a direct effect in reducing out-of-pocket health expenditure and could be helpful for many households to overcome the medical poverty trap. The Ministry of Health and Family Welfare, Government of India launched the “National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS)” in 2010. Initially, the programme was implemented in 100 districts covering 21 states and there was a proposal to expand it to cover all the districts across the country with special focus on strengthening infrastructure, human resource development, health promotion, early diagnosis, treatment and referral for prevention and control of cancer, diabetes, cardiovascular diseases and stroke[43]. Expansion of NPCDCS to all the districts may be helpful in averting many households from the medical poverty trap.

Footnotes

Contributors: AK and SKM have contributed a considerable share of their knowledge and effort. Both the authors (AK and SKM) designed and conceptualized the study. AK analysed the data and drafted the manuscript. SKM finalized the manuscript and gave critical comments on the study.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical Treatment of Experimental Subjects (Animal and Human): This article does not contain any studies with human or animal subjects performed by the author.

Informed Consent: The study used the data set that is available online in public domain; hence, there was no need to seek ethical consent to publish this study.

Funding: This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Data sharing and statement: No additional data are available.

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Figure Legends

Figure 1: Age pattern of death in India by cause of death classification, 2001-03

Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

Figure 3: Age pattern of hospitalization in India, 1995-2014

Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

Figure 6: Costs per hospitalization (in US\$) for communicable diseases, NCDs, injuries and other diseases in India, 1995-2014

Figure 7: Costs per hospitalization (in US\$) by type of diseases in India, 1995-2014

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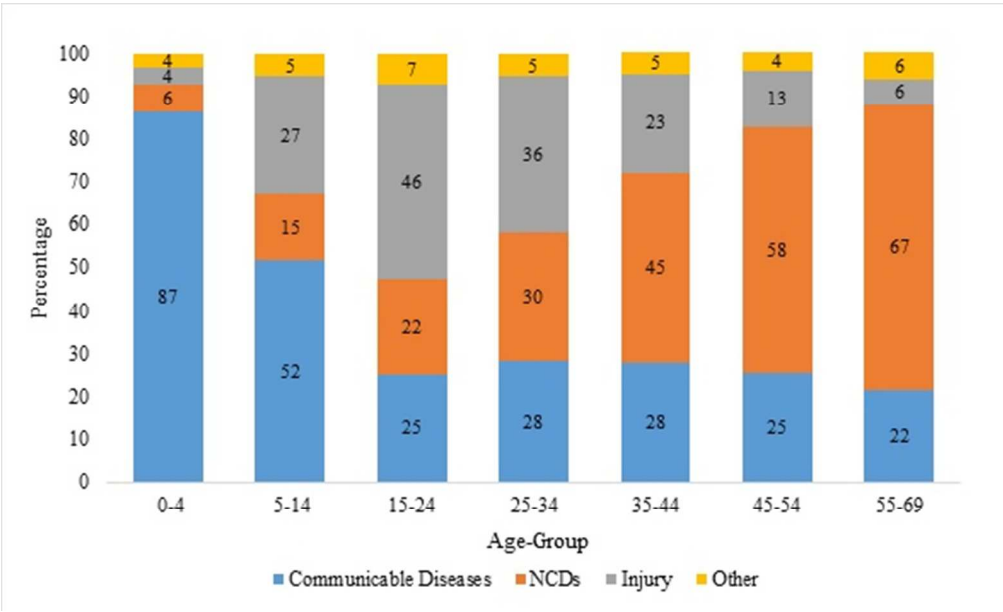


Figure 1: Age pattern of death in India by cause of death classification, 2001-03

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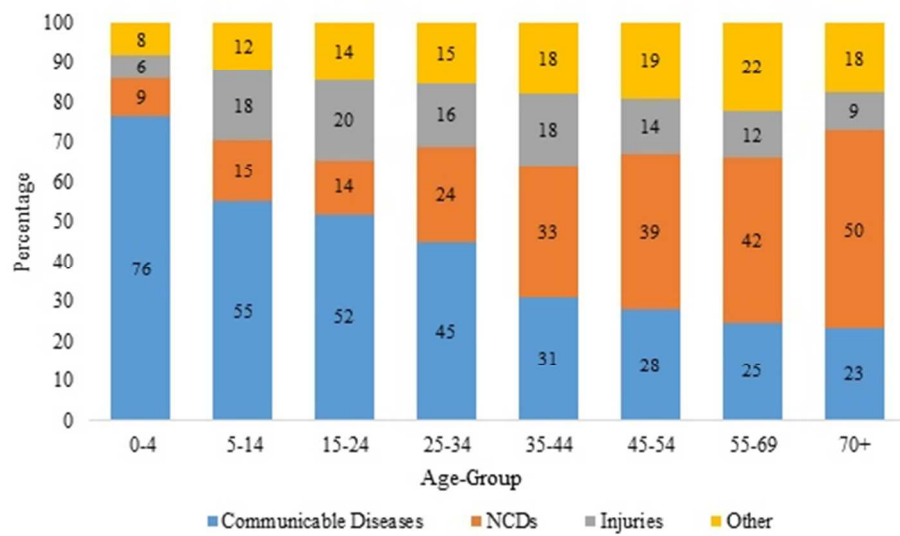


Figure 2: Age pattern of hospitalization in India by cause of death classification, 2014

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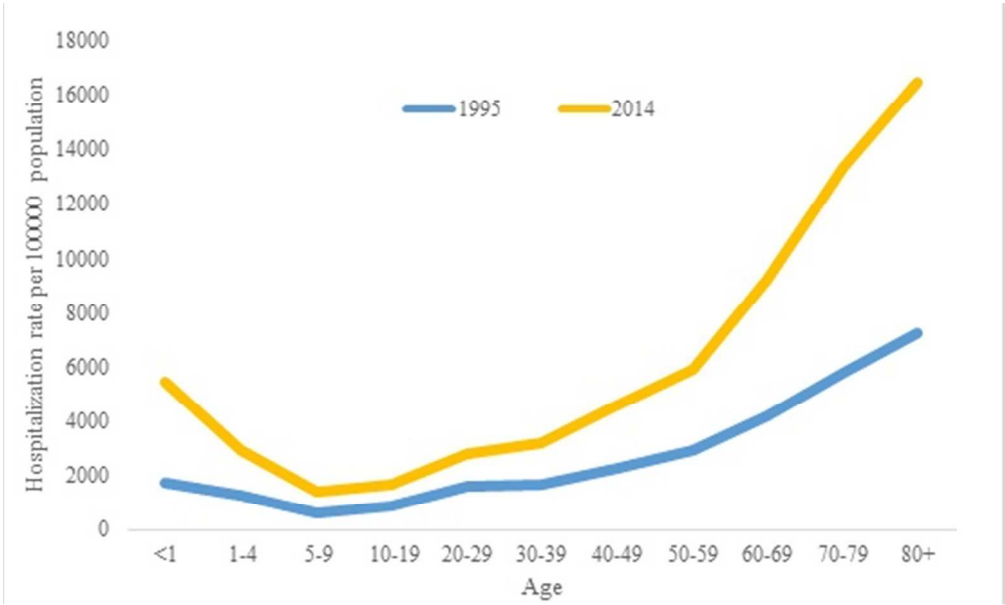


Figure 3: Age pattern of hospitalization in India, 1995-2014

46x28mm (300 x 300 DPI)

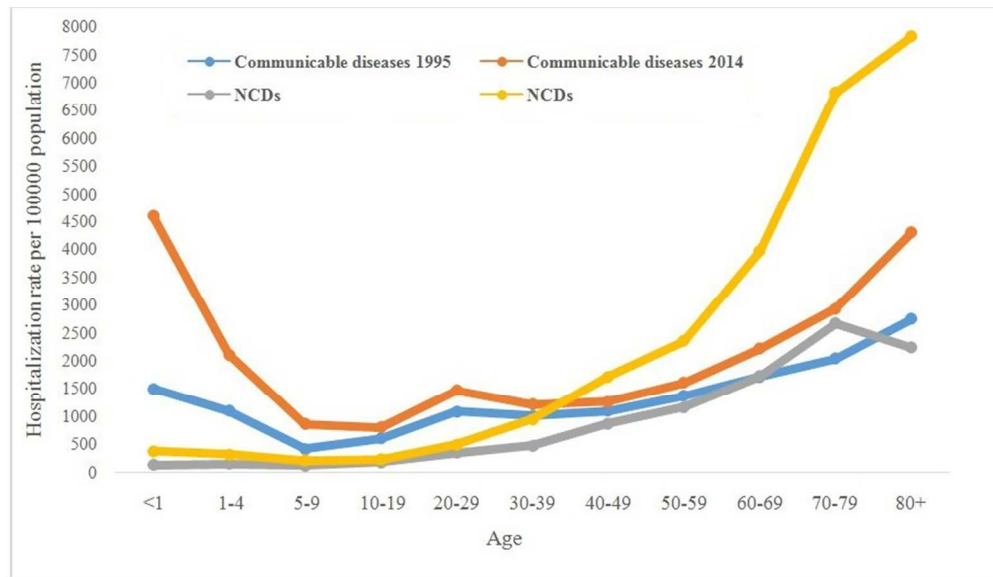


Figure 4: Age Pattern of hospitalization rate (per 100,000 population) for communicable and non-communicable diseases in India: 1995-2014

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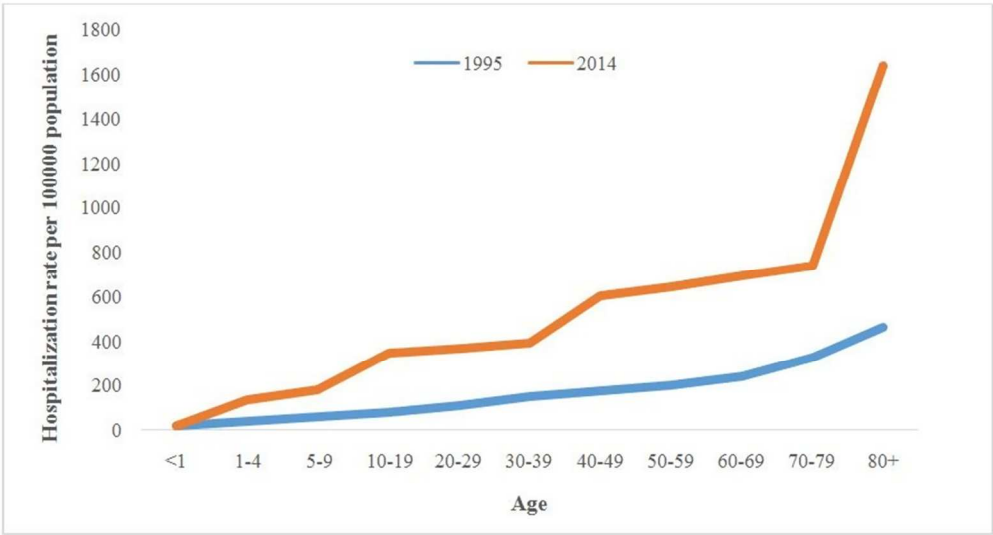


Figure 5: Age pattern of hospitalization rate for injuries in India: 1995-2014

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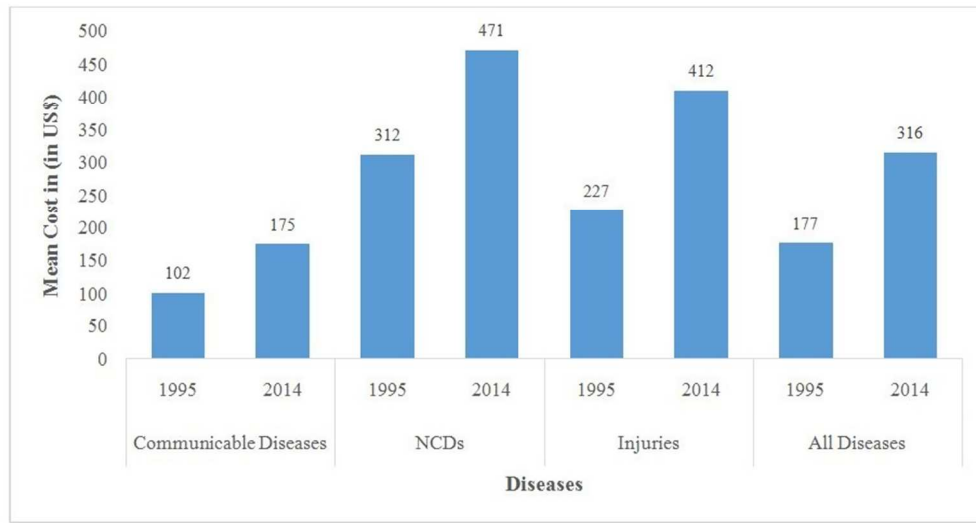


Figure 6: Costs per hospitalization (in US\$) for communicable diseases, NCDs, injuries and other diseases in India, 1995-2014

78x41mm (300 x 300 DPI)

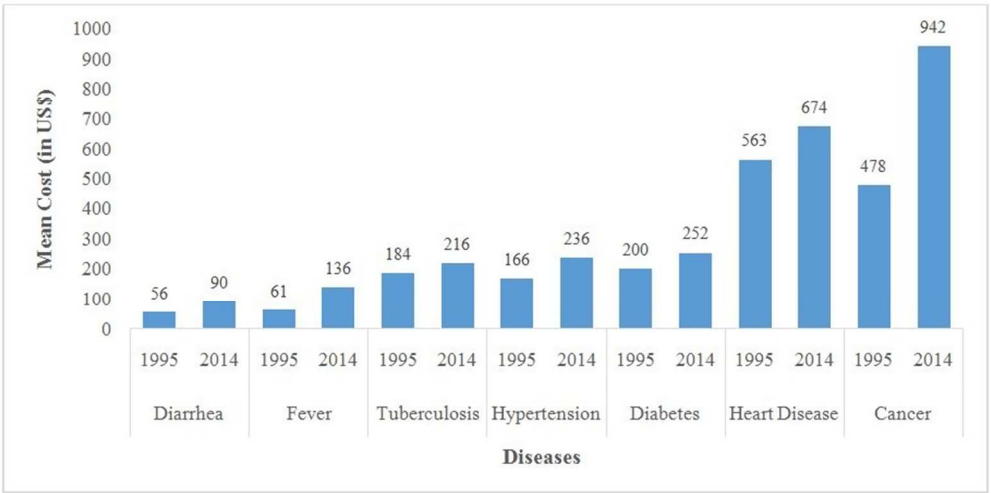


Figure 7: Costs per hospitalization (in US\$) by type of diseases in India, 1995-2014

77x39mm (300 x 300 DPI)